THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXVI. No. 1677.] LONDON, JULY 2, 1895. [47TH YEAR. PRICE 6d.

JAMES OAKES & Co.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.,
Manufacture and keep in Stock at their Works
(also large stock in London)
PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers, and rendering leakage impossible.

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Best Absorbent of Sulphuretted Hydrogen, &c.
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PRICES, &C., ON APPLICATION.

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LIMITED.
LANEMARK CANNEL AND GAS COALS.
Quotations and Analysis on Application to
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Shipping Ports: All the principal Scotch Ports.

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FOR TOWN WATER-WORKS AND OTHER SUPPLIES.
The following Town Water-Works Supplies have been obtained by this System, viz.:—Abbott's Langley, Aldershot, Alnwick, Cirencester, Hertford, Lechlade, St. Albans, Shrewsbury, Skegness, Southampton, Stony Stratford, Swansea, Wallingford, Watford, West Worthing, Wimborne, &c.
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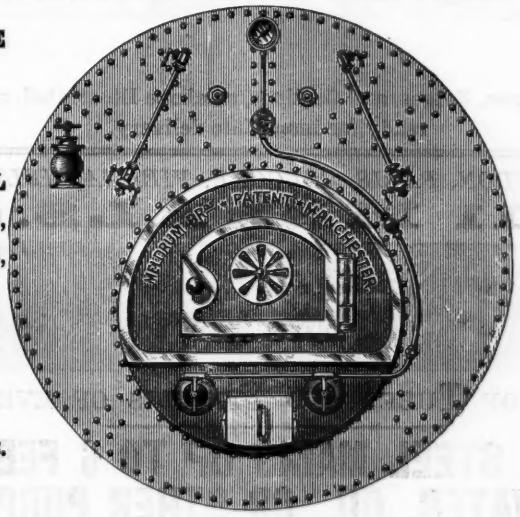

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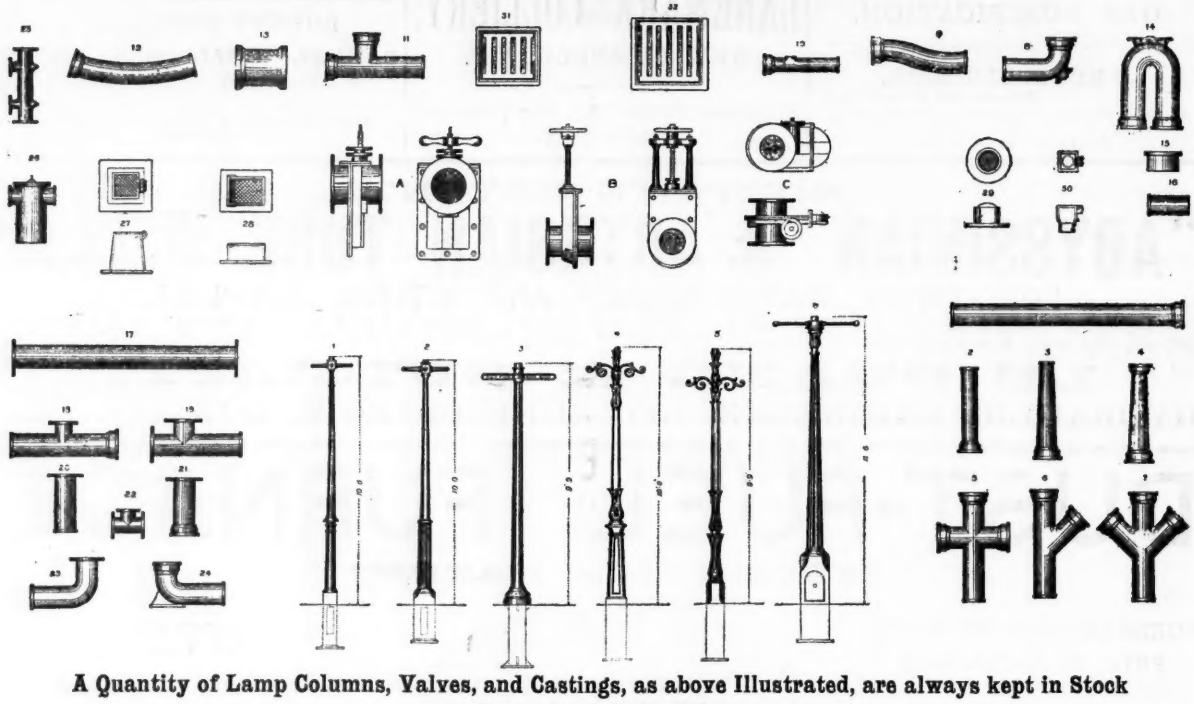

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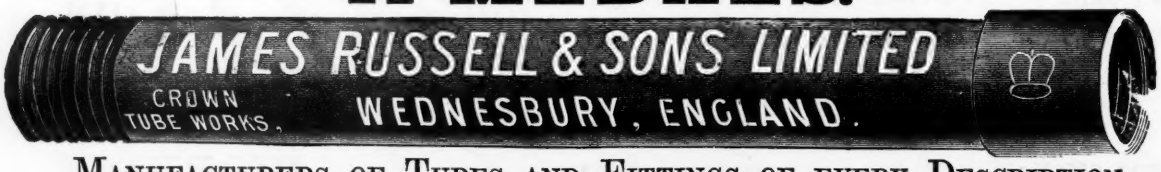

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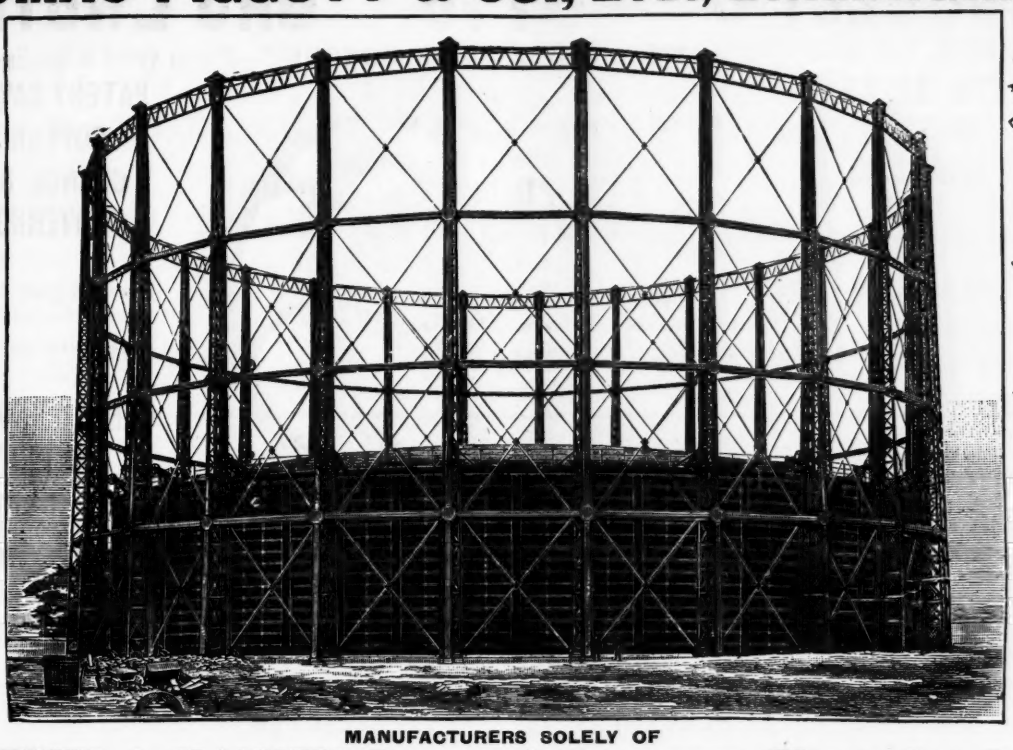

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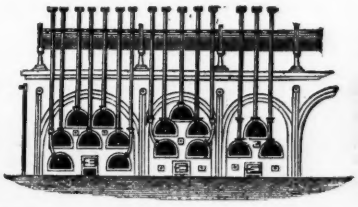

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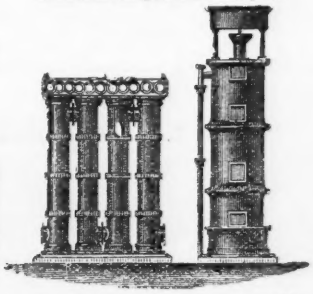

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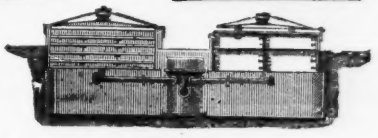

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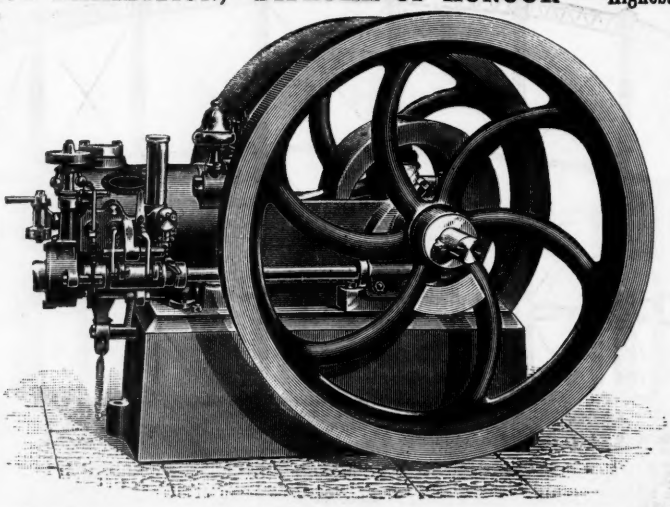

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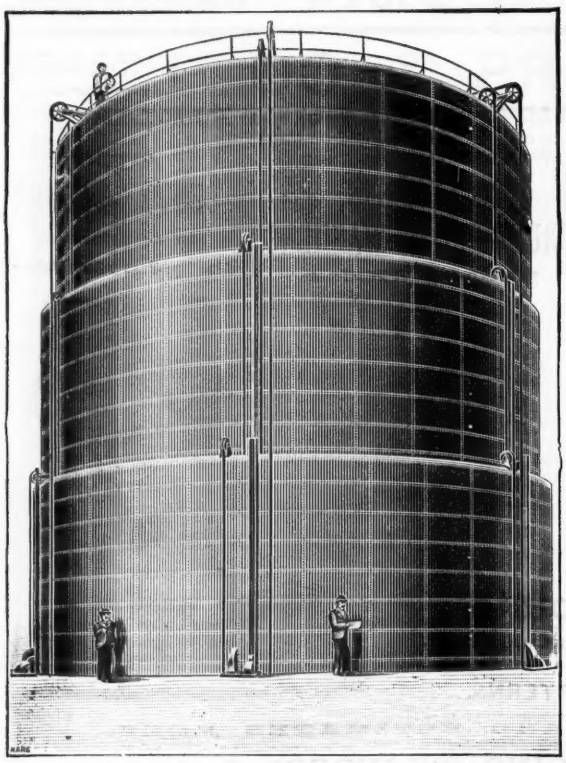

From Photo. of Three-Lift Roped Holder, 50 feet diameter by 18 feet deep each Lift. Erected at Sligo, 1894.

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Pease's Patent Roped Gasholders

THESE HOLDERS HAVE WORKED SUCCESSFULLY UNDER EVERY TEST TO WHICH THEY HAVE BEEN SUBJECTED SINCE 1889.

MAY BE SEEN AT MANY PLACES.

Send for Catalogue if requiring increased Storage.

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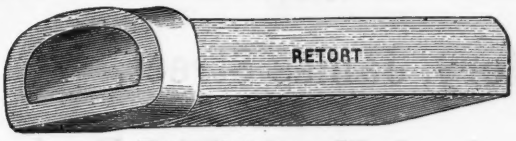

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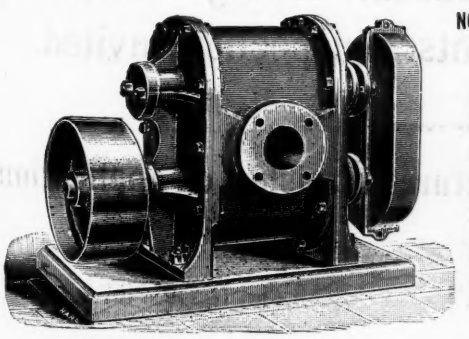
The force of the Piston Pump with the capacity of the Centrifugal combined.

NO SLIDES OR FRICTIONAL WORKING PARTS.



NO PRIMING.

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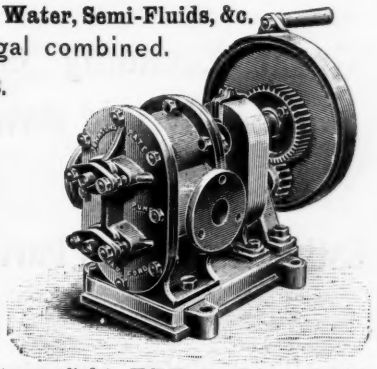

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The Enrichment is **INSTANTANEOUS** and **PERMANENT.**

The Carburettor is inexpensive, easily fixed, and entirely supersedes the use of Cannel.

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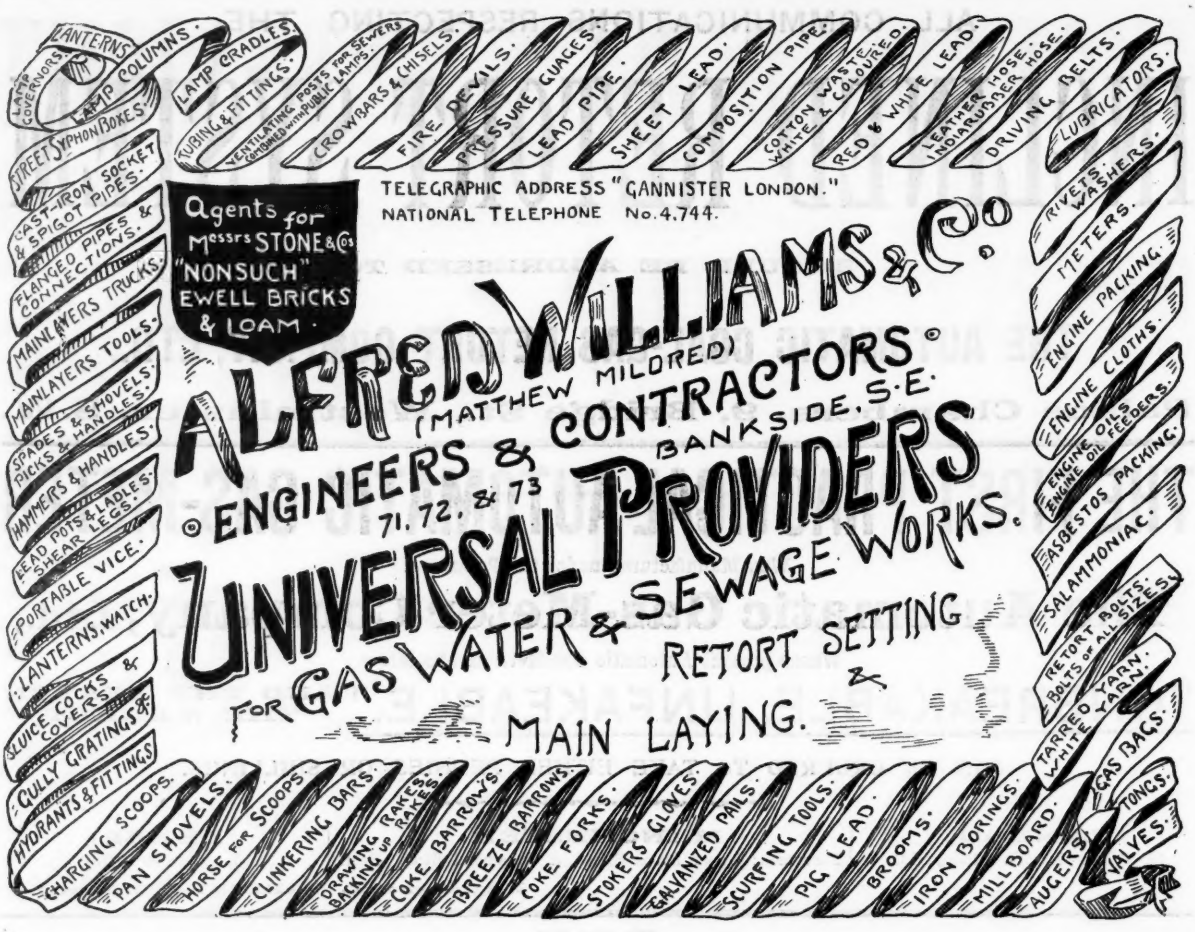
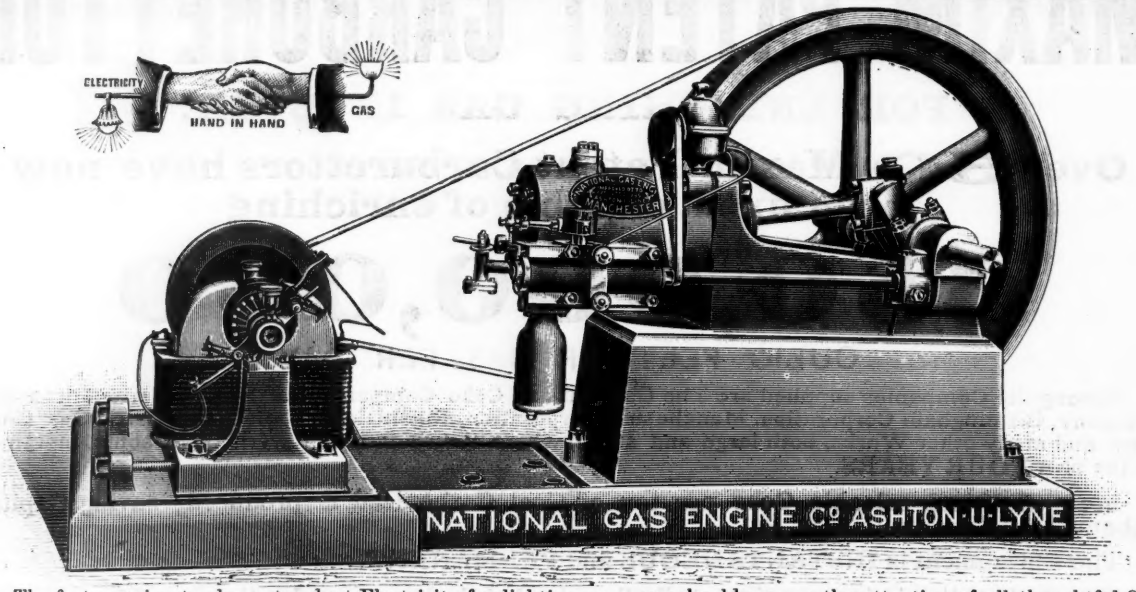


IMPORTANT TO GAS-WORKS MANAGERS



The fast growing tendency to adopt Electricity for lighting purposes should engage the attention of all thoughtful Gas-Works Managers and those interested in Gas Companies.

By the aid of the Gas-Engine driving the Dynamo, **50 PER CENT. MORE LIGHT CAN BE OBTAINED FROM THE SAME GAS**; and thus, by their adoption as the motive power, the gas consumption of the district can be maintained and the light increased.

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COVERS THE INITIAL COST OF THE BURNERS IN FROM SIX TO EIGHT MONTHS.

The PRICES have been REDUCED as follows—

The Ordinary "C" Burner	**Price 10s. 6d.**
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Prices of other Patterns reduced proportionately.

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Which, with a Consumption of 2¼ Cubic Feet of Gas an hour, gives a light of 25 to 30 Candle Power.

This Pattern is particularly recommended where it is desired to effect a large saving in Gas rather than to effect a great increase in the Light.

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The *Lancet* Special Analytical and Sanitary Commission, in an exhaustive report, pronounces the Incandescent Gas-Light System to be the Healthiest, Best, and most Economical System of Gas Lighting.

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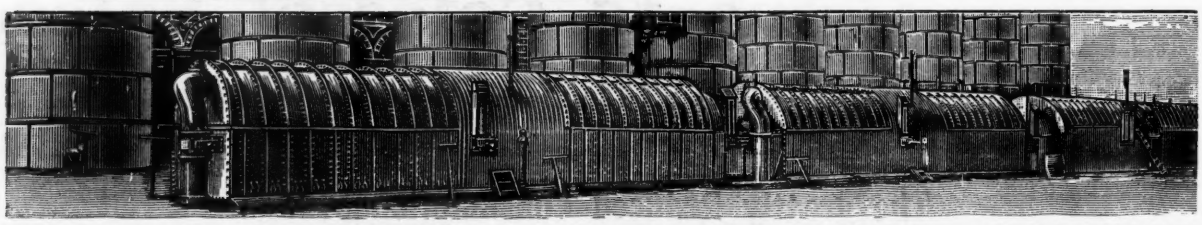
PATENT "STANDARD" WASHER-SCRUBBER

☛ **492** of these Machines (capable of dealing with **472,540,000** cubic feet of Gas daily) in use, which fact is given as evidence of this apparatus being the Most Efficient of any in the Market for the extraction of Ammonia, Carbonic Acid, and Sulphuretted Hydrogen from Coal Gas.



View of SIX PATENT "STANDARD" WASHER-SCRUBBERS, erected at the Beckton Station of The Gaslight and Coke Company (the Engines driving same being under Galvanized Iron Covers). This Company have 30 of these Machines in use. They are also in operation at a great number of Gas and other Works in this Country and Abroad.

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This apparatus being made in sections, the capacity can be easily and cheaply made proportionate to increased make of Gas. Other advantages are: Large and effective cooling area on small ground space, slow speed, no repairs required, high strength liquor obtained, &c.

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Extracts practically all the Tar without choking up, and gives minimum back-pressure.

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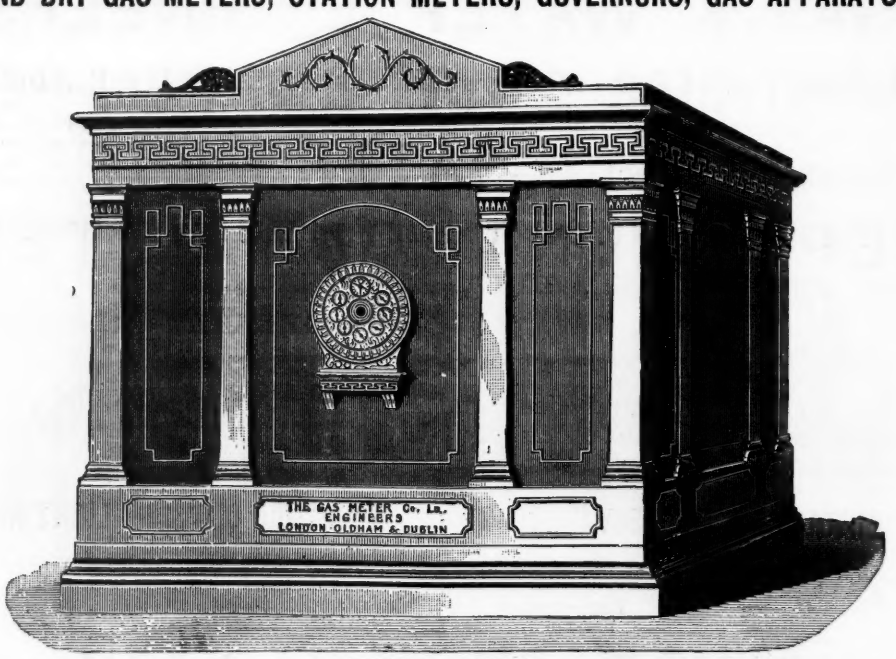

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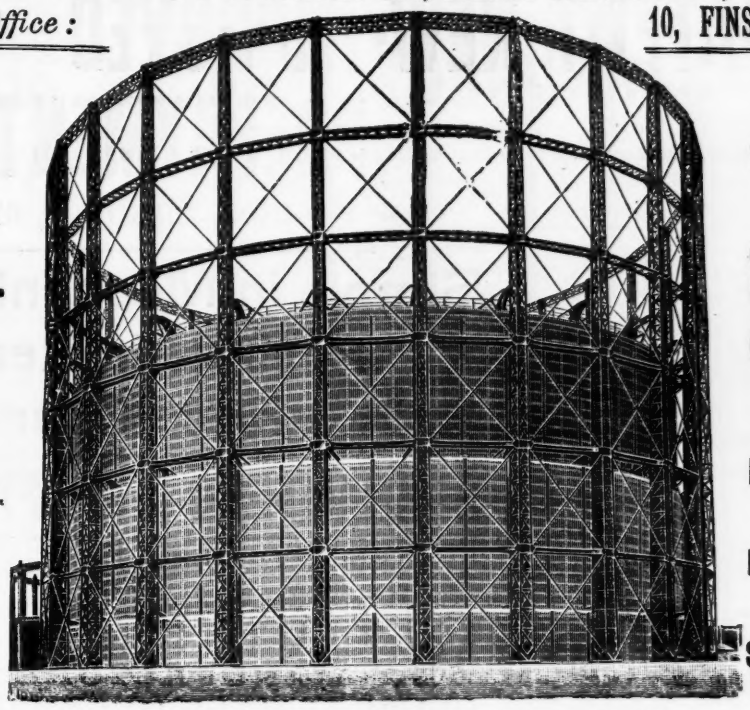
TOWER SCRUBBERS.

WECK'S PATENT CENTRE-VALVE.

CONDENSERS.

TAR PLANT.

SULPHATE OF AMMONIA PLANT.



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WASHERS.

WASHER-SCRUBBERS.

CLAUS' SULPHUR-RECOVERY PLANT.

CENTRE & FOUR-WAY VALVES.

CRIPPS' HYDRAULIC MAIN VALVE.

RETORT-MOUTHPIECES.

SLIDE-VALVES, TAR-BURNERS, SIEVES.

WALKER'S PATENT PURIFYING-MACHINE.

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MANUFACTURERS OF WET & DRY GAS-METERS,

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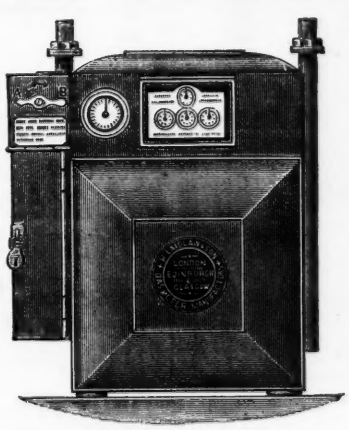

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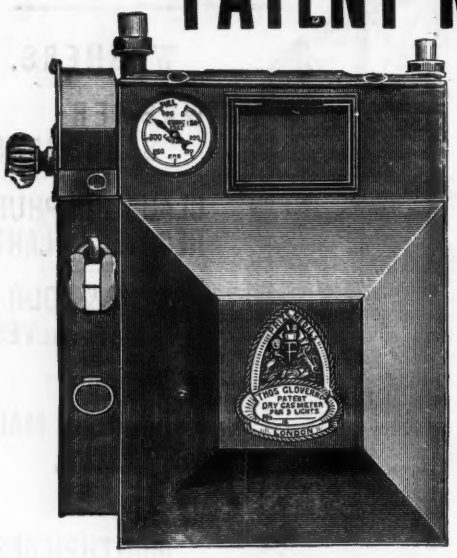

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

EDITORIAL NOTES.

Some Views of Gas-Works Transfers.

THE paper on "The Transfer of Gas and Water Undertakings to Public Authorities," read by Mr. William Newbigging at the meeting of The Gas Institute, is a useful statement of the practice followed in such cases; and if, in advocating the general desirability of arbitration as the best and safest way of ascertaining the bases upon which gas and water transfers can be made, the author laid himself open to the suspicion of chanting the praise of "leather," the impeachment is not a very grave one. He is probably right in this contention, since, though he speaks in his paper of the "commercial value" of a gas or water undertaking, the term is really only applicable to property of this order subject to an important qualification. There is no "market overt" to which either buyer or seller can appeal as the ultimate authority for settling any dispute as to value. The transfer of gas and water undertakings from companies to local authorities is always made by "private "tender;" neither party having the alternative, open to ordinary dealers, of going to public auction. The consideration that there exist instances of local authorities unable to rise to the same sense of the value of their property that is possessed by the proprietors of gas and water undertakings, has moved Mr. Newbigging to suggest a half-measure in dealing with such cases in the public interest. This is that the local authorities might acquire only the distributing portion of the undertaking; leaving the companies to supply gas to them in bulk. In this way, as he truly says, a local authority might at least obtain something which they always make a great point of—the exclusive control of the streets, and the supervision of the purity and illuminating power of the gas. This might or might not prove an attractive expedient in the estimation of the local authority; but one hardly sees where the interest of the gas company comes into such an arrangement. It could never be truly worth while for either party to "take two "bites at the cherry." Such a proceeding, in order to be fair to both sides, would require the safeguard of a provision enabling it to be terminated, after a certain notice, at the option of either. This would be impossible after public money had been raised for the purpose of carrying on and extending the business. At any rate, the suggestion is a creditable one to the author of the paper; for it is no easy matter to infuse the smallest novelty into an essay upon this well-worn subject.

Upon the general question of the expediency of the transfer of gas supply to local authorities, Mr. Newbigging very prudently kept silence; but some "high lights" were thrown upon the question, in the course of the discussion of the paper, by Mr. Alderman Miles, Mr. Stelfox, and others. Time was when the JOURNAL was roundly abused for adhering to the old-fashioned notion that popular elected authorities are not the best qualified bodies for carrying on manufacturing operations. We have not changed our opinions in this regard; and now even those who hold that gas supply ought theoretically to be in the hands of the ratepayers do not pretend that the system has no disadvantages. The thing has been done in many places, and done fairly well; but it is pretty generally understood by now that, as a rule, the consumer of gas or water is no better off under a municipality than he would be under a company. The ratepayer often benefits at the expense of the consumer; but the extent of the benefit and its real value are at best problematical. It is not correct to say, as Alderman Miles did in Edinburgh, with a disregard of the facts of this matter which is almost too general to be called a fault, that the mis-called surplus profits of a gas undertaking administered by a local authority which are paid over in relief of the rates would otherwise have gone into the pockets of a small portion of the community—to wit, the shareholders in the undertaking. He must be quite well aware, if he only thinks for a moment, that shareholders' dividends are a charge of precisely the same nature as the interest upon loans and the sinking fund which every gas undertaking has to pay when it becomes what is called the "ratepayers' property." In fact, it is not the ratepayers' property at all so long as the lender of money for capital purposes has a shilling outstanding upon it. The way in which capital is procured for purchasing gas undertakings from their first proprietors, who are truly the owners, very effectually conceals the real character of the new proprietary. If the money-lender were to hold the same position

in regard to a private business or estate as he does, in thin disguise, in respect of a "ratepayers'" gas undertaking, how much of his business or his estate would the private individual venture to call his own?

People who talk about these matters ought to understand more clearly than they commonly do the fundamental difference between the conditions of a gas shareholder and a ratepayer of a town to which a gas undertaking is stated to belong. The shareholder puts his own money into the gas company; and what he gets in return is his lawful recompense for the use of it. If there is no return, he loses both recompense and principal, and there is no compensation for the loss. The ratepayer does not put a farthing into the gas-works bought in his name, but borrows the money for the purpose, and charges all expense to the consumer; and yet he holds out his hand for the "profits" of the business—meaning hereby the surplus after an amount which would have provided the original proprietor with his dividend has been applied to satisfy and repay the money-lender. If the supply is in the hands of a company of proprietors, the Legislature requires that all the profits of the business shall either be limited to a certain rate, or, if permitted to rise above this rate, shall only do so on condition that, for every extra penny so paid, threepence shall be remitted of the charge levied upon the consumer. The ratepayer, or his representative on the Corporation Gas Committee, does nothing of this kind. He makes the consumer pay the most that can be got out of him, and pockets the surplus; and if only he can point to a neighbouring borough or two where the same course is followed, he thinks himself a benefactor of his town.

A Magistrate's Indiscretion.

LAST week, a Tottenham Court Road tradesman was summoned by The Gaslight and Coke Company before Mr. Hannay, the Magistrate sitting at the Marlborough Street Police Court, for disconnecting his gas-meter, and laying, or causing to be laid, a pipe communicating with a pipe belonging to the Company without their consent. There was no suggestion of fraud in the matter; the defendant having, for reasons of his own, merely moved the meter from the basement of his premises into the area, and made a fresh pipe-connection. The Company prosecuted him because they wished to make it known, in the interests of the public as well as in their own, that no alteration may be made in their pipes without their consent. Defendant's excuse was that he did not know what was the law of the matter; and, having perceived an escape of gas at the meter, he sent for a gas-fitter, and told him to do whatever was necessary, and the fitter shifted the meter. Of course, the man would not have done this except to order; and the fact of the defendant not being aware that, in ordering or countenancing such a tampering with the service-pipe, he was committing an offence, is sufficient justification for the action taken by the Company. The Magistrate thought so too, for he inflicted the substantial fine of £6, with £2 2s. costs, upon the rash householder. If this had been all, it would hardly have been necessary to mention such an ordinary case here. But Magistrates occasionally talk at large about the business brought before them; and on this occasion, Mr. Hannay is reported in one of the daily papers to have talked about the cause of variation in gas bills. This topic does not obviously arise from anything mentioned in connection with the case he had before him. He remarked that he always received a "cautious" reply—the word is probably a misprint for "courteous"—to any complaint he had had occasion to make to the Company, "but he had never yet succeeded in learning from "them why it was that the cost of gas in one quarter some-"times so greatly exceeded that of the corresponding "quarter of the previous year without there having been "any alterations in the habits of the household, or any in-"crease in the number of lights. He sometimes imagined," he went on to say, "that the Company had some means "of compelling the public to use more gas by forcing "it through the pipes with an increased pressure." This observation, according to the newspaper report, was received with laughter in Court. Now, when people in Court laugh after a remark offered by the presiding authority, they are commonly presumed to laugh with the Court rather than at it. On this occasion, there might well have been a different meaning to the laugh; for the Magistrate's remark was undoubtedly both uncalled for and devoid of sense. If Mr. Hannay's intellect had but led him to suspect the Company of doing as he suggested, it might have led him a little farther, and induced him to seek the protection of a governor. The most objectionable aspect of this magisterial utterance is the glimpse it affords of the condition of the mind of a Judge who may at any time have to dispose summarily of a question of the reliability of a meter; for, according to law, consumers' meters are only allowed to be *primâ facie* evidence as to the correctness of a gas bill. It is open to the Courts to reject, upon sufficient contradictory evidence, the indications of a meter index, and to pronounce judgment upon general reasons as to the right amount of a gas bill. Hence it is highly injudicious on the part of any Magistrate to allow observations to escape him in Court which might be construed as indicating the existence in his mind of a prejudice against an order of possible litigants, which, if indulged, would militate against the prospects of their receiving justice at his hands in regard to a particular kind of case.

Questions of Municipal Finance.

AN important question of accountancy in regard to the financial statements of British municipalities has been raised by Mr. George Swainson, the Borough Treasurer of Bolton. Mr. Swainson declares, in a letter to *The Times*, that things have now come to such a pass in connection with the accounts and audit of Parish Councils, County Councils, and Municipalities, that it is high time the public paid attention to the matter. The statement has been made with truth that hitherto the public have been content to suppose that the Local Government Board exercise some sort of supervision over municipal book-keeping; but this is not the case. Moreover, Mr. Swainson remarks that Corporations will never consent to come under the audit of the Local Government as at present regulated, mainly because the system of accounts which the Board insist upon is utterly inadequate to meet present circumstances and requirements. The London County Council will have nothing to do with the system, which follows the Poor Law Board method of stating "receipts and payments" instead of employing the proper basis of "income and expendi-"ture." Mr. Swainson justly points out that the Board of Trade requirements in regard to the accounts of gas, water, and electricity supply undertakings are based upon the principle he favours; and he asks why it is that the other Government Department is so differently advised. He asserts that the recent trouble at Salford was occasioned almost entirely by failure to bring the year's income and expenditure properly into the accounts for rating purposes; and he declares it to be quite possible to have a system of municipal book-keeping which would be easy of audit, and would yet prevent such a condition of things.

Upon another point of municipal book-keeping, Mr. Swainson has recently read a paper before the Corporate Treasurers' and Accountant's Institute. This refers to the capital statements of municipal undertakings. It is the ruling of the Local Government Board Audit Department that, as municipal loans are paid off, the asset to which they correspond must be written down by an equal amount; so that by the time the loan is paid off, the asset also disappears from the books. That is to say, if a municipality have paid off £50,000 of a gas loan of £100,000, the undertaking is only entered as worth the outstanding capital sum. This is, of course, nonsensical from one point of view. Mr. Swainson argues that all assets should be entered in the books at their first cost, so long as they continue to serve the purpose for which they were created; and that all accounts relating to them should be based upon revenue and expenditure. The latter requirement is just; but as to the former, it may be objected that it would be quite as misleading if, in a corporation balance-sheet, the corporate property were always to be entered at its first cost. This might be an improvement upon the Local Government Board system of wiping out what is paid off; but it would form no better guide to the financier or the ratepayer as to the real state of the municipal finances. A town hall or a bridge may be regarded as worth to the municipality just the figure at which it was first entered in the books, so long as the structure serves its proper purpose. But in the case of these unproductive, or not immediately productive, classes of property, their cost is really a liability; so that they only belong to the community so far as they are paid for. A new road bridge, for example, will represent a liability for its cost of (say) £10,000; but it is never a realizable asset, even when paid for. In the case of a gas undertaking, however, we have the example of a piece of municipal property which is always realizable, but is not truly

worth either the amount of the outstanding capital loan or the figure at which it was originally acquired. It has a commercial and structural value; and ratepayers ought to be able to find out what these values approximately are from the annual accounts of the municipality. There is no reason for a gas company proclaiming what the directors regard as the purchasing price of their property; but there equally does not appear to be any reason why municipalities who have nothing to fear from such publicity should not tell the people what the corporate property is worth.

Mr. James Dougall, youngest son of Mr. Andrew Dougall, the Engineer and Superintendent of the Hull station of the British Gaslight Company, Limited, has been appointed Engineer and Manager of the Hoylake and West Kirby Gas and Water Company, Limited.

Honours and Appointments on the Change of Government.—Among the honours and appointments which Her Majesty has been pleased to approve, on the recommendation of Lord Rosebery, in consequence of the recent change of Government, are the following: Mr. Arthur Arnold, the Chairman of the London County Council, is to receive the honour of knighthood; Mr. R. Giffen, C.B., the Comptroller-General of the Commercial, Labour, and Statistical Department of the Board of Trade, and Colonel V. D. Majendie, C.B., the Chief Inspector of Explosives for the Home Department, are to be promoted to the rank of K.C.B.; and the Hon. E. Chandos Leigh, Q.C., the Speaker's Counsel, is to be a C.B.

Mr. Ellery's Gas Institute Paper.—We are asked by Mr. C. Stafford Ellery to correct an error as to the returns of the make of sulphate of ammonia given in the second paragraph of the paper read by him at the recent meeting of The Gas Institute, and published in the JOURNAL last week. The figures in the first column are for the year 1892 (not 1894). The report for 1894 had not reached Mr. Ellery when he was preparing his paper; but he intended to add the figures for that year, which are as follows: Gas-works, 113,634 tons; iron-works, 10,075 tons; shale works, 32,891 tons; coke and carbonizing works, 3448 tons—total, 160,048 tons. The totals for the three years will stand as follows: For 1890, 134,257 tons; for 1892, 149,826 tons; for 1894, 160,048 tons.

Groves and Thorp's "Chemical Technology."—We have received from the Publishers (Messrs. J. and A. Churchill, of New Burlington Street) the second volume of the above work, which deals with the subject of "Lighting." Reserving for a subsequent issue of the JOURNAL a fuller notice of the book, we may mention that it contains five sections, in which the following subjects are treated by the gentlemen named: "Fats and Oils," by Mr. W. Y. Dent; "The Stearine Industry," by Mr. J. M'Arthur; "Candle Manufacture," by Messrs. L. and F. A. Field; "The Petroleum Industry and Lamps," by Professor Boverton Redwood; and "Miners' Safety-Lamps," by Professor Redwood and Mr. D. A. Louis. The third volume, comprising gas and electric lighting, lighthouse illumination, and photometry—these subjects being deal with by Mr. Charles Hunt, Dr. Garnett, Professor Redwood, and Mr. W. J. Dibdin—is nearly ready for issue.

The German Association of Gas and Water Engineers.—The thirty-fifth annual meeting of this Association was held on the 19th, 20th, and 21st of June, at Cologne, under the presidency of Herr Wunderlich, of Leipsic. It was decided that next year's meeting should take place in Berlin. Among the papers read was a valuable one on Westphalian gas coals, by Herr Hegener, of Kalk. In it he reviewed the history of the winning of coal in Germany from the inception of the gas industry, with special reference to the opening up of the Westphalian coal-fields. Dr. Knublauch spoke on the subject of "Nitrogen in Coal;" especially referring to the extraction of cyanogen compounds from gas, and the conversion of hydrocyanic acid into ferrocyanogen compounds, to the total exclusion of sulphocyanides. Herr W. von Oechelhaeuser, of Dessau, gave particulars of the gas tramway in that town. Dr. Bunte read a paper on recent discoveries bearing on gas lighting; treating particularly of the addition of acetylene to illuminating gas. He concluded that, at the present cost of production, acetylene could not compete with benzol as an enriching material. He alluded briefly to the rare earths used in the manufacture of mantles for incandescent gas lighting, to a spirit-lamp for lighting on the incandescent principle, and to the discovery of argon. Herren Hasse, Hegener, and Grahn made communications on settings of inclined retorts; and Dr. Schilling, of Munich, and Herr von Gässler, of Hanau, treated of carburetting with benzol. Dr. Bueb, of Dessau, described his observations on the congelation of aqueous and other vapour in gas-pipes, and recommended the addition of alcohol vapour as a preventive of freezing. Dr. Leybold, of Frankfort-on-the-Main, discussed the position and work of the gas-works' chemist. There were less important communications from Herren Kallmann, G. Wunder, Joly, Dr. Polis, and others; and the annual report was presented by Dr. Bunte, the Secretary of the Association. By reason of the number and importance of the papers read, the meeting of 1895 was one of the most successful in the annals of the Association.

WATER AND SANITARY AFFAIRS.

THE Parliament on which the London County Council built all their hopes with regard to the water question is now about to dissolve; and with it—according to present appearances—go the eight Bills by which it was proposed to effect an extraordinary "transfer" of more than thirty millions' worth of property. Concerning the Bills, we may venture to say we shall never see their like again. The Select Committee under Mr. Plunket have gone far enough with the consideration of these measures to make it plain that the Bills, as originally framed, required very material alteration, in order to fit them for the approval of the Legislature. If this were the case under the administration of Lord Rosebery, much more may such a result be expected under the rule of Lord Salisbury. We are fairly justified in making the assumption that the new House of Commons will be less subservient to Spring Gardens than the one which is passing away. All is now changed—or soon will be; and although the County Council may not allow the question of the water supply to remain at rest, they cannot fail to see the necessity of approaching the subject in a much more reasonable spirit than they have displayed in the past. Their favourite arbitration clause, wonderful in its structure and audacity, has been scattered to the winds. At a special meeting convened for the purpose, they have been content to substitute another clause, by which they hoped to satisfy the Select Committee, and at the same time promote their own wishes. It seemed as if their ingenuity had not been wholly unsuccessful; and there was the prospect that, with some little modification, the new clause would be accepted by the Committee. But there was another essential matter in which the Committee proposed to intervene, so as to secure justice to the Companies. Mr. Pember was pleading that the principle of placing the water supply in the hands of a County Council could only be worth anything by being universally applied, when the Chairman said the Committee would be disposed to insert a clause in the Lambeth Bill providing for the purchase of all the undertakings, and not merely part. Another announcement was also of great significance, as affecting the terms of the transfer; the Chairman saying it was the intention of the Committee that the Arbitrators should have an unfettered right to award a sum in respect of compulsory sale. The circumstance that the exercise of this right was to be purely optional, does not detract from the importance of introducing this matter of compulsory sale as something to be taken into consideration. The plan of the Council, at the outset, was to exclude the subject altogether, though the principle was partly admitted—or perhaps we might say was artfully superseded—in the new arbitration clause, by allowing the Arbitrators to award a "further sum," beyond "the fair "and reasonable value," in order to meet the cost of reinvesting the purchase-money. The Committee, however, desired that these words should be so amended that the element of compensation for compulsory sale should be brought clearly within range of the arbitration. It is also to be noted that the Committee hesitated to pronounce an opinion as to that part of the new clause which provided that, on all points, the discretion of the Arbitrators should be exercised "as fully and effectually as could be done by "Act of Parliament."

After all the deliberations respecting the Transfer Bills, just when the question seemed to be ripening towards some kind of conclusion, there came a "chilling frost," in the shape of a dissolution of Parliament. At first the Committee thought the Bills could be held over during the dissolution, and taken up again. But Mr. Plunket stated on Thursday that they had been advised to the contrary; the Bills not having reached the stage when such a course could be adopted. The case was so much the worse, seeing that six of the Transfer Bills had not even reached the second reading. The Money Bill relative to the transfer was also in arrear. Mr. Balfour Browne still indulged the hope that the Committee might leave the Bills at a stage at which they could be taken up by the next Parliament; but Mr. Plunket said there seemed no chance of this, though the Committee would meet on Wednesday (to-morrow), in case there might be a favourable change in the course of affairs. Thus it seems inevitable that an enormous expense has been incurred, and a vast amount of trouble taken, without any immediate result. We qualify our regret, despite the

excessive burden cast upon all the London Water Companies, because it seems to us that something has really been gained. It is plain that the Transfer Bills would never have been passed in the form in which they were presented. Opinions, amounting to decisions, have been expressed by the Committee, which must govern any future attempt to acquire the property of the Water Companies. Facts have been brought to light which will modify many preconceived notions in the public mind. The ratepayer has been invited to look into the pit which has been dug for him, and which he may be expected to avoid in the future. The water question no longer stands where it did; and the County Council will henceforth have to face a tribunal different from that on which they have hitherto reckoned. The Companies have no particular reason to desire that the Transfer Bills should be suspended and revived. The Bills are essentially bad; and though Mr. Plunket's Committee did their best to mend them, it was hardly possible to make them the basis of a workable scheme. The Companies have reason to regret being dragged into the conflict, seeing how much it has cost them; but, upon the merits of the case, they have lost far less than the County Council. The Council have lost heavily, and have gained nothing; only it happens on their side that the ratepayer has to find the necessary money.

Truth is sometimes spoken by accident. A few days ago, the *Daily Chronicle*, in discussing the water question, made this striking declaration: "As for the river water, "it becomes clearer every day." We were prepared to welcome the announcement, as a sign of returning sanity; but, on reading the next few words, we found that the complete sentence became merely a repetition of former vagaries. Thus, concerning "river water," we were told: "It becomes clearer every day, not merely that its sanitary "safety is doubtful, but that there is the gravest reason to "consider it an active agent in the promotion of disease." Now the "clearer" light is showing every day the very contrary of this. Mr. Shirley Murphy, by bringing the vital statistics of London down to the close of 1893, has exhibited an increase in the zymotic death-rate in that year, compared with the average of the years 1885-92. The rate is thus shown to have risen from 27·1 to 30·4 per 10,000. But in Mr. Shirley Murphy's next annual report, a different result will have to appear; the zymotic death-rate in 1894 being down to 26·6 per 10,000, which is even below the average of 1885-92. So also concerning the death-rate from all causes in London, Mr. Shirley Murphy shows that the lowest mortality in 1871-93, both inclusive, was in 1889, when it stood at 18·4 per 1000. Since then, matters have been worse, and the death-rate has been higher—becoming 20·9 in 1893. But the fact has now to be recorded that in 1894 the London death-rate fell to 17·8—a lower point than even the rate for 1889. By excluding the deaths occurring in Metropolitan institutions of persons ascertained to be strangers, the death-rate of London in 1894 is reduced to 17·4 per 1000. It therefore becomes "clearer," as time goes on, that, if vital statistics afford any test, the water supply of London is favourable to health. On what other source of information does the *Daily Chronicle* rely?

Association of Municipal and County Engineers.—The annual meeting of this Association was held at Halifax on Thursday and Friday of last week, under the presidency of Mr. E. R. S. Escott, the Borough Engineer. The members assembled in the Town Hall, where they received a cordial welcome from the Mayor (Alderman M. Booth). The annual report read by the Secretary (Mr. T. Cole) stated that the Association now entered upon the twenty-first year of its existence. During the financial year ending April 30 last, 56 ordinary members and 17 graduates joined the Association; and at its close there was a total membership of 646—a net increase of 47. The audited accounts showed a balance of £235 14s. 4d. in hand; and the invested capital at the end of the year stood at £300. The report was adopted. The President then delivered his Inaugural Address, which was followed by papers and discussions on appropriate topics. Thursday evening, the members dined together. On the following day, the rest of the papers were taken; and the remainder of the available time, as well as Saturday morning, was occupied in visiting various works in the district. Among these were the gas, water, and electric lighting works of the Corporation, where the members were received by Mr. T. Holgate, Mr. J. A. Paskin, and Mr. T. P. Wilmshurst, the Engineers, and by Mr. W. H. D. Horsfall, the Architect of the electric lighting station. A visit was also paid to the retort, fire-clay, and brick works of Messrs. Oates and Green, Limited, at Horley Green and Ellen Royde.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE THIRTY-SECOND ANNUAL GENERAL MEETING,

HELD AT THE

QUEEN STREET HALL, EDINBURGH, JUNE 11, 12, & 13, 1895.

ROBERT MITCHELL, Esq., President.

PAPERS AND DISCUSSIONS.

[*Continued from Vol.* LXV.]

THE PRACTICE OF DISTRICTING WITH A VIEW TO EQUALIZING PRESSURE.

By F. W. CROSS, of Wellington, Salop.

In the paper about to be read to you, it is not guaranteed to introduce anything particularly novel in the way of gas engineering, or of a highly technical character. However, upon looking over the index of the past Transactions of this Institute, it was with some surprise—and, indeed, gratification—that the writer found that this subject had not been particularly dealt with; for having had a slight personal experience in the matter of districting somewhat out of the ordinary course of events, it was felt that, in taking up this question as a maiden effort for presentation to the members of the Institute, there would be one distinct advantage already gained—viz., not being handicapped with the thought that it was absolutely necessary to improve upon what had been previously said upon the subject, or under a similar title. Notwithstanding the fact that in choosing a subject this was the first impression that presented itself to my mind, you are asked to believe that, in the relation of personal experiences, it has been my endeavour to state them to the best of my ability in such a manner that may, it is hoped, prove at once both interesting and instructive, and at the same time tend to promote a discussion equal to the importance of the subject. It is proposed to lay before you a plain statement of how, during my residence in Hong Kong, we overcame the difficulties of high and low pressures in the various districts of the city, which continually forced themselves on the attention of the Manager as the area of supply expanded and the demand for gas increased.

It would at first be well to describe the topography of the area of supply; this being necessary for you to duly appreciate the advantages and disadvantages of the locality. To do this, it is needful to draw your attention to a photograph of the City of Victoria on the island of Hong Kong, as also to the street plan of the city, for which I am indebted to the courtesy of Messrs. John Bartholomew and Co., of the Edinburgh Geographical Institute; they having allowed me to enlarge their map of the city in outline. The city is built on the side of a steep hill, rising more or less abruptly from the sea-level to a height of 1800 feet. It has a frontage on the water of between 3 and 4 miles; and in the centre (where are situated the principal business houses and European residences), you will note the streets and houses rise very rapidly, tier upon tier, to a height of about 600 feet above sea-level. The Praya, Bund, or roadway fronting the water is absolutely level from end to end. While the gas-works are located at the extreme west end of the city, some large consumers are situate at the extreme east end; and it is proposed first to deal with the difficulties arising out of this difference in position, though equality in level, and the distance of the demand from the supply, which was over three miles. You will note that, while the Praya is not quite continuous from end to end of the city, the street immediately to the back of it is so; and in this street—called for the whole of its length the Queen's Road—the trunk main of the city is laid. Where the continuity of the Praya is broken, you will see that on either side of Queen's Road are situated the naval yards and military barracks; and these, as a matter of fact, divide the city into two parts—the portion of Queen's Road between being (if it may be so expressed) the link in the chain joining the west and centre of the city to the eastern portion.

From the works we start with a 12-inch main, diminishing gradually to 10-inch, 8-inch, and at the extreme east end to 6-inch and 4-inch mains; and these constituted the trunk main for the supply of gas to the several districts of the city. It is needless, and would be superfluous, for me to explain, how that, as the gas passes through

the centre of the city, where the greatest demand exists, its great and natural tendency is to fly upwards; and though at one time it was quite possible to obtain a respectable and workable pressure at the east end, ultimately the demand in the centre grew so great as to diminish the pressure at the east end to such a degree as to render the volume of supply a practically useless quantity. The supply of gas to the higher levels in the centre of the city has at all times been more or less controlled by district governors; and as the area of supply expanded and the demand increased—diminishing the pressure on the lower levels—the maximum pressure given at the works was increased to meet the contingency. There came a period, however, when it was deemed undesirable to further increase the pressure, for many obvious reasons, without some change in the mode of distribution.

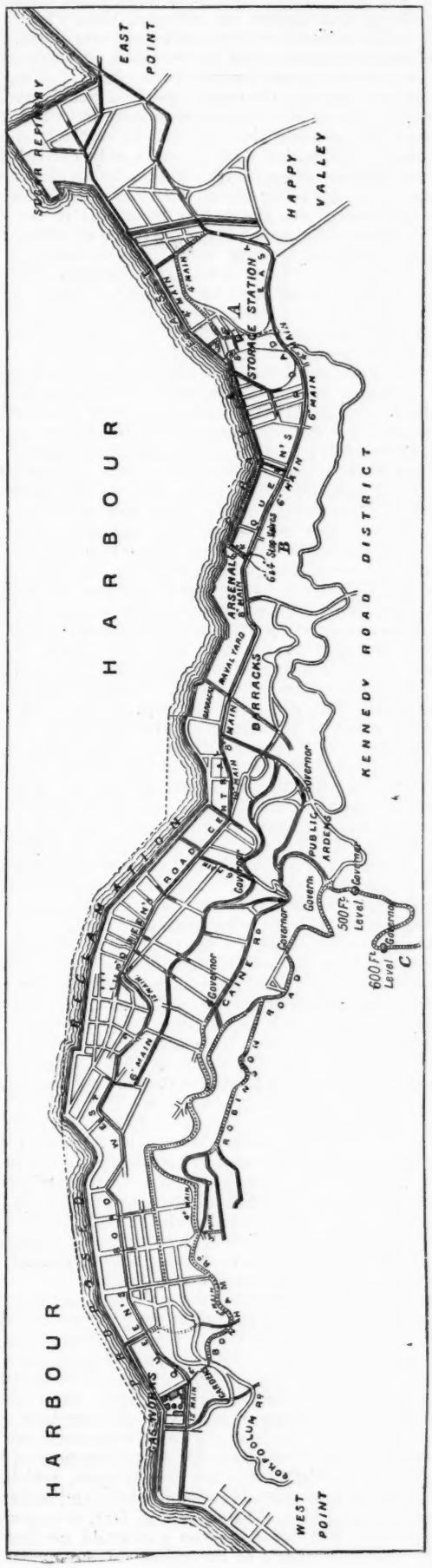
At this time, while we were giving a maximum pressure on the works of 25-10ths, the pressure at the inlet of the main supply meter of a large sugar refinery at the east end was at its maximum only 8-10ths; and this was still further reduced during exceptional draughts on the mains, which would occur occasionally, and which it was not always possible to provide for. This refinery was supplied by the Company through one large meter, fixed at the entrance of the premises; but there were subsidiary private meters for checking the consumption of each of its various departments. It can therefore be understood that at times the pressure in the different parts of the works was very low indeed; and it is not surprising that occasionally it reached vanishing point.

In course of time, this trouble of low pressure grew more and more acute; and when it became necessary to make provision for increased storage accommodation, a consideration of this matter showed that an admirable opportunity here presented itself to once for all overcome the difficulties of pressure hitherto experienced. The area of the existing works being limited and fully occupied, it was decided to erect the new gasholder in the east-end district of the city, and by means of distribution from this station—independent of, or in combination with distribution from the manufacturing station—to equalize the pressure over the whole of the lower level district.

The scheme that is about to be brought before you in its general outlines, without entering into minute details of construction, was formulated by Mr. C. R. Mead, the Managing-Director of the Company; and the works were designed by Mr. Frank Mead, of Sutton, Surrey. The whole of the extensions were carried out under the personal superintendence of the writer.

A telescopic holder, of ample proportions for future demand, was erected on a plot of land marked A on the plan, about 2¾ miles from the existing gas-works; and the mode adopted for supplying the holder with gas from the manufacturing station is shortly described. The existing 8-inch main in Queen's Road terminated at a point marked B on the plan at the junction of Queen's Road and Arsenal Street, leading to the eastern portion of the Praya. This point was a little over two miles from the works; and in passing, let me draw your attention to one of the natural advantages of this locality. As previously mentioned, when describing the topography of the district, the intervening property between this point B and the centre of the city on both sides of Queen's Road was wholly occupied by the naval yards and the military barracks—practically dividing the city into two portions, east and west, with these properties acting as a buffer between them. Here, then, was a district already formed, which only required a re-arrangement and development of the system of distribution. From the point marked B, an 8-inch main was laid along the Praya direct to the storage station; and this new portion was untapped the whole of its length—in fact, it was essentially a trunk main to supply the new holder with gas. Under many circumstances, the supply of gas to a holder erected at a distance from the works would have been conducted by a trunk main from the manufacturing station to the storage station, without any branches or connections being made. In this case, beyond the new portion of 8-inch main laid along the Praya east, the ordinary town main from the works up to the point marked B was utilized, and made to act as a trunk main for the supply of gas to the storage station.

At the storage station was erected a building containing a duplicate set of exhausters of 10,000 cubic feet per hour capacity, driven by two gas-engines—one vertical



STREET PLAN OF THE CITY OF VICTORIA, HONG KONG.

and the other horizontal—each of 3 nominal horse power. The exhausters were not coupled direct to the engines, but were driven by a system of belts, countershaft pulleys, and riggers so arranged that, while the engines could be driven at a constant minimum speed, the speed of the exhausters could be increased or diminished at will by a re-arrangement of the driving belts. Also, by the use of loose pulleys, the engine was first put in motion and the exhauster started when convenient, and when the engineman was assured that all was in working order. The filling of the holder with gas was only carried out during the daytime, generally between the hours of 10 a.m. and 4 p.m.; the gas being drawn from the manufacturing station and forced into the holder by means of the exhauster. During the period of the operation of filling the holder, the pressure at the works was maintained at 12-10ths; and when all was at rest at the storage station, a similar pressure could there be obtained. When, however, the exhauster was started, the speed was so regulated that the inlet pressure was reduced to about 6-10ths to 8-10ths, consequent upon the draught on the mains.

To avoid risk of carelessness or inattention of the engineman, a bye-pass connected the inlets and outlets of the exhausters; and herein was inserted a patent equilibrium gas-governor, capable of being so regulated that it was a moral impossibility for the pressure to be so reduced as to interfere with the day supply to the centre of the city. To illustrate this, let me mention that on the Queen's Road level in the centre of the city a gas-engine was in use every day, generating electricity into accumulators for a private establishment. This engine required for its working that 10-10ths pressure should be maintained at the works. Twelve-tenths pressure was put on during the period of running the exhauster at the storage station; and as in response to inquiries, no complaint was made, it must clearly point to the fact that the action of the exhauster in regard to excessive diminution of the pressure was not felt in the centre of the city. It may be said that the gas-engine was not delicate enough to show any appreciable effect of the action of the exhauster at the storage station; but by careful observations made from day to day, the writer never noticed the slightest pulsation in the centre of the city, except with such a delicate light as the incandescent gas-light, which he personally overcame by an adjustment of the bye-pass governor. At the station itself, when the exhauster was in action, a slight pulsation was observed, and showed itself on the register paper; but this could be regulated to a minimum by the bye-pass governor—the minimum oscillation shown on the inlet of the exhauster being about $\frac{1}{8}$ inch.

You will note that, previous to its entry to the station, the gas had to pass through a length of over half a mile of untapped 8-inch main; and for a further distance of over a quarter of a mile—that is, in the portion of Queen's Road between the naval yard and military barracks—the connections off the 8-inch main were throughout the daytime practically unused; and the action of this long length of dead main was to greatly minimize the effect of the pulsation taking place at the storage station. Telephonic communication existed between the gas-works and the storage station; and in case of sudden storms or darkness (which were of not unfrequent occurrence) necessitating extra pressure for short periods, it was possible to immediately stop working, and direct the whole of the day pressure on the centre of the city. The gas being stored both at the east and west ends of the city, it was, of course, easily possible to distribute the same so that the pressure should be equalized throughout the whole of the district.

There were two outlet-mains from the station; the gas being controlled by a patent equilibrium governor common to both. One was a 6-inch main connected to the existing mains supplying the east-end district, which required very little re-arrangement—valves being inserted to entirely sever this district from the centre of the city. Here, then, was the first object accomplished—viz., the supply of gas to the eastern district at an equal pressure to that obtained at the works, or in the western and central portions of the city. The other outlet was an 8-inch main, which in reality acted as a bye-pass between the inlet and outlet of the holder, so that at night-time—or, in fact, at any time the exhausters were at rest—the gas could be passed from the gasholder back to the centre of the city from the same main that it had previously travelled in to the station. Here, again, the second object in view was accomplished—viz., the utility of the works as additional storage accommodation; for at time of short supply at the manufacturing station, assistance could be rendered by passing gas back from this holder to the centre of the city.

On several occasions tests were taken to notice the effect of the pressures; but previous to my leaving Hong Kong, no necessity had arisen for a continuation of this mode of equalization of the distribution. My experience, however, forced me to the conclusion that occasions would arise when an available stock of gas at the east end would be an invaluable adjunct to the storage capacity of the manufacturing station. In addition, as the area of supply expanded, this station was so situated, and the mains so arranged, as to meet the demand in a very simple manner, and at much less expense than if it had to be met by a re-arrangement of the mains from the manufacturing station.

The whole of the objects to be obtained by these arrangements will be quite apparent to my hearers; and it will hardly be gainsaid that they were secured in an expedient and most inexpensive manner. To have run an entirely new trunk main from the manufacturing station to the new storage station would have been expensive; and even then there would have been several questions to consider in deciding the merits of the two systems. Brief mention is made of one or two that occur to me.

(1) The pressure of gas in the trunk main, which would have resulted in a heavy leakage account owing to the nature of the subsoil to be traversed.

(2) The pressure given by the single-lift holders on the manufacturing station was only 4 inches, while the pressure given by the telescopic holder at the storage station was $5\frac{1}{2}$ inches when cupped.

(3) The system of a direct trunk main would not so easily have adapted itself to the return of the gas to the centre of the city and the equalization of the pressure over the whole of the district.

The supply from this station was started on Jan. 1, 1893; and the writer only had about three months' experience of the working before leaving Hong Kong. During this period, the station was used more or less simply as a storage station, and for the supply of a portion of the eastern district, which took about 12,000 to 13,000 cubic feet per 24 hours.

In January, the horizontal engine worked during 17 days for $88\frac{1}{4}$ hours, while the vertical engine worked during 12 days for $51\frac{1}{2}$ hours; and the consumption of gas by the engines for the whole of this period was 6500 cubic feet, inclusive of work done in pumping water into the gasholder tank, &c. The working was more or less experimental for the first month or so; but in February, the results improved. The horizontal engine worked during 11 days for $44\frac{1}{2}$ hours, while the vertical engine worked during 12 days for $57\frac{1}{4}$ hours, with a consumption of gas for the whole of the period of 3900 cubic feet, inclusive of work done in pumping. These working results may, upon analysis, appear to be somewhat negative; but it must be remembered that they were for the first two months of working, more or less experimental, and particularly while a Chinese engineman was being trained to his duties. There is no doubt, however, that since then, as the working became more regular, and as the engineman became more accustomed to the apparatus, greater efficiency has been obtained, and greater economy exercised in the working. This is borne out by the fact that, from information received since this paper was written, the figures for the corresponding months of January and February, 1894 and 1895, give the consumption of gas per 1000 cubic feet pumped—viz., January, 1894, 8·92 cubic feet; February, 1894, 8·57 cubic feet; January, 1895, 6·25 cubic feet; February, 1895, 6·41 cubic feet. The attendance required was simply a Chinese engineman at $15 per month, and a Portuguese or Eurasian night watchman at $16 per month; and but for the fact that in Hong Kong it was needful to employ a night watchman to protect the premises, this service could be dispensed with by the use of an automatic pressure-changer attached to the governor.

Let me now draw your attention to a further matter having a bearing on the subject of districting and equalization of pressures. During recent years, the Peak and hills above the city of Victoria have been developed into building sites, and a large number of European houses erected thereon. In addition to private residences, two very large hotels have been built; and in 1889, when

building operations were being carried forward to a large extent, the Directors agreed to my proposition to carry gas to this increasing suburb of the city. Our supply at that time extended to a height of about 600 feet above sea-level; the mains for the last hundred feet in height, though considerably more in length, being principally of wrought iron. This wrought-iron piping was taken up, and a cast-iron main laid in its place; and from a point just above the last residence on the hillside (marked C on the plan), the main was as far as practicable carried almost straight up the side of the hill, with a rise varying from 1 in 2 to 1 in 4, to the "Gap" about 1200 feet above sea-level. From this point it branched off in two directions—a 3-inch main running in the direction of the Peak to the west, and a 4-inch main to the east, which was a more level district, and more thickly built upon. The main supply of gas at this time came from the centre of the city, and, as previously mentioned, was controlled by district governors on its ascent to the higher levels.

To control the direct supply to the Peak, we had one governor fixed at about the 500-feet level, and another at the 600-feet level; these being used to control the gas and give the necessary pressure to the houses on these levels. From the governor on the 600-feet level, the gas was unobstructed in its ascent right away to the "Gap," or 1200-feet level; but it was there controlled by a governor previous to its branching off east and west to the districts of supply. During the first year or so of the supply of this new district, we experienced a certain amount of trouble in adjusting the pressures and the flow of gas to be given by the governors; but this was nothing beyond what had been anticipated. Gradually, however, a fairly heavy winter consumption developed itself in this new district; and at the same time the consumption on the 500 and 600 feet levels had been gradually increasing. Then our troubles came faster; and complaints were made as to insufficiency of pressure on these comparatively lower levels—especially so at or about the dinner-hour, between 7.30 and 9 p.m. This had to a certain extent been foreseen; but it was hardly expected to come so quickly. The question had to be met, however; and in carrying out this object, the writer was enabled to partially execute a scheme for generally equalizing the pressure on the higher city level, as also to avoid making such a heavy drain on the supply to the centre of the city.

From the works situate at the extreme west, we carried a 4-inch main through some gardens to a height of about 200 feet. This main ascended very rapidly—and, in fact, in some portions of its length it was quite vertical; and the gas therefore reached the top at a very good pressure. Here it entered into a 6-inch main, and was carried along a slightly ascending road for a distance of about three furlongs; and where it again commenced to rise, the 6-inch main branched off to 4-inch and 3-inch mains—the 4-inch main continuing on the level, and the 3-inch main making a gradual ascent till it reached the 500-feet level, where it joined the direct supply to the residences on the higher levels and to the Peak. Here the gas received its first direct check since it left the works, by the governor on the 500-feet level; and after regulating the governors on the 500 and 600 feet levels, corresponding to the alteration in the nature of the supply, no further great trouble was then experienced. The 4-inch main mentioned was carried along at about the 300-feet level—replacing old and smaller mains—till it joined a 4-inch main already laid on this level above the centre of the city; and, by a more circuitous route, also furnished a supply of gas to the mains leading to the higher levels and to the Peak. Other subsidiary mains were laid about the same time and provision was made to form a system; but what has been described embodies the main features of the scheme.

As showing how the development of the Peak district affected the supply to the lower or intermediate levels, it may be mentioned that the increase in consumption for several years was as follows:—

12 months, 1889 to 1890, consumption per consumers' meters was 482,600 c. ft.					
12	,,	1890 ,, 1891	,,	,,	660,900 ,,
12	,,	1891 ,, 1892	,,	,,	1,788,900 ,,
9	,,	June 1, 1892, to Feb. 28, 1893	,,	,,	1,936,200 ,,
12	,,	Feb., 1894	,,	,,	2,622,000 ,,

Thus on all the levels the pressure was more or less equalized and controlled from either the manufacturing station at the west end or the storage station at the east.

As time progresses, natural expansion of the European residential locality will no doubt take place upon the higher levels to the east of the city, on the Kennedy Road district—this being more or less foreshadowed by the schemes of the local government—and then by means of a branch from the 8-inch main to the east of the city (west of the Military Barracks), or by a direct main from the storage station at the east end (provision for which has already been made), this new district may be fed without disturbing the pressures maintained on any portion of the existing system.

In preparing this paper, the fact has not been lost sight of that the experiences given refer exclusively to Hong Kong; and the same difficulties might not apply to some towns in this country. At the same time, there are probably localities in Great Britain and other parts of the world somewhat similarly situated to what has been described; and if what has been written proves of any slight assistance to my professional brethren, or is sufficient to provoke a discussion at this meeting, the writer will feel quite satisfied in this his first appearance on the stage of The Gas Institute.

Discussion.

Mr. W. R. Chester (Nottingham) said that the author, having a peculiar district to supply, had adopted certain means for equalizing the pressures of the higher and lower levels; and he spoke in certain places of a patent equilibrium governor. It would be interesting to know what that governor was; and how it answered the purpose. A district such as Mr. Cross described seemed to be admirably adapted for the distribution of the gas from one central station; and he (Mr. Chester) thought it would be found that the establishment of an additional storage station was only a mitigation of the difficulty of supply, and not a permanent remedy. Putting down an additional storage station at the extreme end of the district would undoubtedly enable the Company to tide over the difficulty of short supply during the hours of greatest demand for a time. But as the consumption continued to grow, it would be necessary to enlarge the mains on the lower levels; and he believed if this had been done in the first place, instead of constructing an extra storage station, it would have cost less, and have been more effective. The cost of substituting a 12-inch main for an 8-inch and a 4-inch would not amount to much more than £4000 for the whole length of four miles; and he did not think the cost of the storage station could be much less than that. Again, a second station involved the addition of certain permanent charges to the cost of distribution, beyond interest—such as the charge for an engine-man, a night watchman, &c. These together could not be much less than the equivalent of the interest on £1000 of capital; and if this were added to the expenditure for the provision of the gasholder, &c., he thought the money could have been more advantageously spent on the original works and the enlargement of the trunk mains. The difference in level which Mr. Cross had to contend with—1800 feet—was no doubt extraordinary; and it was a matter of interest to all to note the way the difficulty had been overcome. He congratulated Mr. Cross on his first appearance as the reader of a paper before The Gas Institute.

Mr. Cross, in reply, said the equilibrium governor was one of Cowan's; and it answered admirably. With regard to the suggestion that the supply might have been sent from the works by a rearrangement of the mains at the west-end station, he could only say that the area of the city in width was absolutely limited—it must expand in length; and, therefore, with the storage station at the extreme east end, if the demand should grow very great at the extreme east, it simply meant a new trunk main from the west end to supply more gas than could at present be drawn through the town live mains.

THE COMBUSTION OF COAL GAS FOR FUEL PURPOSES.

By Vivian B. Lewes, of the Royal Naval College, Greenwich.

Nothing is more remarkable in the history of gas than the improvements which have taken place during the past twenty-five years in the methods by which light can be developed by its use; and, whereas at the beginning of this period it was considered to be a good performance if a

burner developed 3 candles per cubic foot of gas consumed, at the present moment it is possible to develop nine times this amount of light from the same quantity. The reason for the extraordinary activity which has taken place in this direction is probably due to the threatened rivalry of electric lighting; and it can hardly be claimed that the perfection of methods for the consumption of gas for fuel purposes has kept pace with its consumption for illumination. At the present time, the most important problem for the future of gas manufacture is how best to popularize gas as a fuel, and to convince the public of the enormous advantages which they would gain by the adoption of it for general use in place of solid fuel.

From the point of view of health, cleanliness, convenience, and comfort, everyone is, I think, agreed that gas is immeasurably superior to coal for fuel purposes. Not only would the general adoption of coal gas as a fuel do away with the heavy pall of smoke which hangs over a big town, and prevents the sun's rays from carrying out the beneficent work which Nature intended them to perform, but it would also reduce to a minimum the number of fogs from which a big town suffers, and would in this way quickly reduce the death-rate due to lung diseases; and the best energies of the gas industry should undoubtedly be devoted at this period to popularizing gas as a fuel, as by so doing not only can the gas industry be increased to enormous proportions, but also because of the hygienic improvements which would follow its adoption.

In order to bring about these much-to-be-desired results, every improvement in the method of burning coal gas which may be produced should claim the attention of the manufacturer of gas-stoves; and the object I have in view in this paper is to, as far as possible, discuss in what direction any improvement may be possible. Although we owe much to the magnificent enterprise of our leading gas-stove manufacturers, it would be sheer folly to suppose that we have reached anything like finality in our methods of gas consumption.

The only point which militates against the use of gaseous fuel in all big towns is the assumption that it is much more expensive than solid fuel; and if the thermal units developed by the ordinary bituminous coal and by coal gas be calculated out, coal has a very substantial advantage. Taking a fair sample of bituminous coal, its composition will approximate to—

Carbon	80·0
Hydrogen	5·0
Sulphur	1·5
Moisture	4·0
Nitrogen	1·5
Oxygen	5·0
Ash	3·0
	100·0

And the calorific value will be 8020 thermal units.

The composition of London coal gas approximates to—

	Volume.		Weight.
Hydrogen	52·0	..	9·6
Unsaturated hydrocarbons—			
(C_2H_4)	3·0	..	7·7
(C_6H_6)	1·0	..	7·1
Saturated hyrocarbons (CH_4)	34·0	..	49·9
Carbon monoxide	5·0	..	12·8
Nitrogen	4·5	..	11·5
Carbon dioxide	0·0	..	0·0
Oxygen	0·5	..	1·4
	100·0	..	100·0

And the calorific value of such a gas will be equal to 11,918 thermal units; or, roughly speaking, weight for weight, the value of the coal is two-thirds that of gas as a fuel. Taking the specific gravity of London coal gas at 0·4, 1000 cubic feet would weigh 32 lbs. Taking now 2s. 8d. as the price of the gas per 1000 cubic feet, we find that it costs us 1d. per pound; while the average cost of coal in London is about 10 lbs. for 1d., or 0·1d. per pound.

The thermal value of the coal, however, is only two-thirds that of the coal gas; so that we may say that, for equal thermal values, in round figures, the coal is seven times cheaper than the illuminating gas. This would probably be the line of argument taken by the scientific coal merchant. Any arguments based upon the thermal units which a fuel is capable of developing, although of value as constituting a standard of comparison, are misleading and valueless when we come to apply them to every-day practice. A carefully constructed calorimeter may bear out your theoretical deductions, but your boiler and your fire-grate certainly will not; and it seemed to me of the greatest possible importance to the gas industry that an attempt should be made to see what the ratio between coal gas and coal really is at the present time, and also to ascertain to what degree of efficiency our gas-stoves have attained, and, if possible, to note the direction in which improvements could be made.

To make any such determinations of value, it was necessary to carry out the experiments with every care as to exactitude in measurement of the gas consumed, and of the increase in temperature, and yet to have the conditions such as would be found in practice. The room selected for the experiments was 17 ft. 4 in. by 15 ft. 7 in., and 11 ft. 1 in. high; giving a cubical capacity of 3032 cubic feet. It had three windows and one door—the latter being opened twice in the hour, to allow the observer to pass in and out during the test; this and all other operations being conducted in such a way as to make the tests strictly comparative.

All the stoves tested were fitted exactly as they would be arranged when fixed by an experienced gas-fitter—*i.e.*, the opening of the fireplace was closed by a metal plate, through which the elbows from the gas-stoves passed; and thermometers were arranged in various parts of the room, so as to give the temperatures at various distances from the stove from the floor-level and each two feet up to the ceiling.

My first intention was to apply to the various makers for samples of their stoves for testing; but I finally came to the conclusion that it would be fairer to obtain them as sent out into the market. Mr. George Livesey kindly lent me a selection of those stoves which experience had shown him as most in demand with the public. These were—

Fletcher's B.R. 12, Complete "Hong Kong" and Richmond's "Gordon" and "Majestic." ["M.P."
Wright's "Queen Ball" and No. 2884.
Davis's "Kent" and No. 1 LSN.
Main's "Princess" and No. 458.

In the testing of these stoves, the gas supplied to them was carefully measured by an accurate meter; and the temperatures in the room were taken every hour over a period of five hours. Two tests were in this way taken of each stove; but only one test was taken on each day, so as to allow the temperature of the walls, and atmosphere of the room, to reach its normal condition again. The tests for each stove differed but little amongst themselves; and the results taken were the mean of two sets of tests.

These tests, extending as they did over a period of nearly three months, form an enormous mass of figures, and represent the efficiency of most of the stoves at present used in England. But as the publication of these figures might have an injurious effect upon trade interests, I feel that it would be better to leave it in the hands of the Council of the Institute as to whether they should be published or not. If it is decided that it is judicious to publish them, they will be arranged as an appendix to this paper in the Transactions. But I may state that out of the eleven stoves tested, four gave results not very widely separated, while of the remaining seven, there are only two really unsatisfactory, and give 50 per cent. less than the best stove.

The result given by the best stove was an increase in temperature of 6·5° Fahr. in the first hour, and a total increase of 13° Fahr. in five hours, for a consumption of 200 cubic feet in the five hours, or an average of 40 feet per hour, which is equal to 1° Fahr. rise in temperature for each 15·4 cubic feet of gas consumed, or practically speaking 2° Fahr. for each pound of gas.

Consuming bituminous coal in a grate of the ordinary construction, and of the kind used in certainly 90 per cent. of our homes, it required an average of 7 lbs. of coal an hour to raise the temperature to the same extent as with the gas-stove.

Under these conditions, therefore, 35 lbs. of coal give in a room the same warming effect as 200 cubic feet or 6·25 lbs. of coal gas. In other words, 1 lb. of coal gas does the same amount of heating as 5·6 lbs. of coal—the gas costing 1d. and the coal only a shade over ½d.

The initial consumption of coal to give the necessary increase in temperature is greater than with gas; and the saving in waste of fuel secured by being able to turn off the gas when the temperature is too great, or when the fire is done with, practically obliterates the difference in cost, when intermittent (not continuous) heating is required; while with rooms used only for an hour or two in the day, gas is really far cheaper than coal as a fuel.

In order, however, to thoroughly popularize gas, we

ought to strive to burn it in such a way as to develop the greatest possible heating power from it, and to at any rate make it equal in cost as a fuel for continuous heating to coal burnt in the ordinary grates. Nor must we lose sight of the fact that, with the best forms of open grate using solid fuel, the coal consumption can be reduced from 7 to 4 lbs. per hour to give the same effect as the 40 cubic feet of gas consumed in the best stove, which would make the gas three times as dear as coal.

Before attempting to consider how this can be done, it will be well to gain an idea as to the causes of the loss of heat with gas-stoves, and how far these can be overcome. When a room is being warmed by any form of stove, heat escapes by—(1) Hot products of combustion going up the flue. (2) Absorption of heat by the walls of the room. (3) Hot air removed by ventilators, and cool air brought in. (4) Leakage from doors and windows. The last three factors of loss are due to the room itself, and will act practically equally with solid or gaseous fuel; while the amount of heat escaping up the chimney is largely dependent upon the construction of the stove.

Whatever views may be held on the subject, I myself feel very strongly that the idea that some forms of stoves can be used without being attached to a proper flue is not only most dangerous to health, but also militates against the use of gas as a fuel, by encouraging the idea that gas-stoves are unpleasant and unhealthy as sources of heat. It cannot be insisted upon too strongly that a gas-fire, whether used for heating or cooking, must be connected with a flue; as the products of combustion are just as deleterious, if not so dirty, as those given off by the combustion of solid fuel. To gain an idea of the percentage of heat lost by the flue, the gas-stove before used was placed in the centre of the room; and the sheet-iron elbow being removed from the opening at the back of the stove, the iron rim soon became sufficiently heated to enable the escaping products of incomplete combustion to burn there with a blue flame. The consumption of 200 cubic feet of gas in five hours raised the temperature of the room 35° Fahr. above the initial temperature; and as an increase of 13° Fahr. was obtained when the stove was in its proper position, and connected with the flue, this showed that practically nearly two-thirds of the heat which could be utilized for warming the room escaped up the chimney.

It must not be supposed that the whole of this lost heat is due to heated gases, which could be made to give up their heat before being finally discharged into the chimney; as wherever you have an atmospheric gas-flame employed to heat substances like asbestos in a gas-stove, a considerable percentage of inflammable products of incomplete combustion escape unburnt. They are, to a large extent, responsible for the flame which is found burning at the exit flue of a gas-stove; and if the gas be passed through chambers in which the heat contained in the flame is given up either to radiating substances or the air, and so brought back into the room, these products of incomplete combustion simply escape unburnt up the chimney and are lost.

In order to obtain an approximate idea of the amount so lost, the stove was once more connected with the flue, but by a thin iron pipe, which was 1¾ feet in length from the front of the plate closing the fire-grate space and the back of the stove; and it was found that the extra heated surface thus provided brought the efficiency of the stove up to more than 75 per cent. of the loss before noticed—the unaccounted-for loss being mainly due to unconsumed products of incomplete combustion.

Having now gained an idea as to the efficiency of the stoves at present used, it becomes possible to consider how this efficiency can be increased. It is, I think, now thoroughly recognized that it is impossible to do away with the products of incomplete combustion as long as the heating flame is brought in contact with any surface cooler than itself. In other words, the only way to get complete combustion is to allow the flame to burn itself out without contact with any other body; and the only form of stove in which, as far as I know, this has ever been attempted, was one in which flat luminous flames were burnt in the top of the stove, and the light and radiant heat were reflected out into the room by a concave copper reflector placed below the flames. But the small amount of heat radiated by a luminous flame burning under ordinary circumstances was so small that this stove was never very efficient.

Many forms of stoves which heat the room rapidly depend upon either hot-air chambers or a certain length of flue between the stove and the flue, in order to utilize a proportion of the heat which would otherwise escape up the chimney. But such stoves have two important drawbacks. In the first place, the thin iron of which the flues or air chambers are composed soon gets heated to a high temperature; and under these conditions carbon monoxide, which is the most deleterious of the products of incomplete combustion, freely diffuses through it, and escapes into the room—vitiating the air, and quickly giving rise to a feeling of oppression and headache. This principle, therefore, should only be used for stoves in which flame burns unchecked, and where, consequently, the combustion is perfect. Secondly, the largest part of the heating is effected by warming the air of the room, and not by radiant heat, which is wrong. Radiant heat does not directly raise the temperature of the air, but is radiated to the floor, walls, and furniture in the room, which again slowly part with their heat to the air in contact with them, and to the inhabitants, so that the walls and solid matters in the room are at a higher temperature than the air.

Apart from its being much more healthy to breathe cool than hot air, there is another important point to be considered. The normal temperature of the body is 98° Fahr., 36·8° C.; and this temperature is maintained by the slow-combustion processes going on in the body. By the laws of radiation, a heated surface parts with its heat more or less rapidly according to the temperature of the surrounding bodies; so that if a person be sitting in a room filled with warm air, but near a wall colder than the air, his body will rapidly part with heat by radiation to the wall, and a sensation of chill is the result. But with an open fire this is never the case, as the radiant heat from the fire heats the walls of the room to a temperature higher than that of the air. When, however, a room is heated by means of warm air, the walls not being heated in the same proportion, though the air may feel warm, the walls remain cold; so that the heat of the body would pass by radiation to the walls, and give rise to a chill.

A good gas-stove should not depend too much for its heating effect upon discharging warm air into the room, but should distribute a considerable proportion of its heat by radiation, and so raise the temperature of the floor and furniture in the lower parts of the room. Most of the gas-stoves tested complied with this requirement—notably the three best ones; the floor and the first 2 feet above the floor-level being at a higher temperature than the next 6 feet, while, as might be expected, the hottest air was next the ceiling.

On now attempting to discover methods of improving the service of our gas-stoves, one's thoughts naturally turn to regeneration, the application of which to illuminating flames marked the first step in the great advance which has taken place during the last two decades. The genesis of modern forms of regenerative lamps really sprang from using the principle in the construction of a gas-stove; and it is fully realized that the greatest drawback to a regenerative burner is the enormous amount of radiant heat it emits.

It can readily be proved that, as the temperature of a luminous flame is raised, the amount of heat radiated by the incandescent carbon particles increases at a far greater ratio than the heat of the flame itself; so that, by raising the temperature of the flame by only (say) 150° C., you will enormously add to the power of heat radiation. I have made experiments on this point, and find that a flame on being raised 256° C. in temperature, by regeneration, emits 250 per cent. more radiant heat—90 per cent. of this, however, being radiation from the heated regenerator. The 256° C. increase was a rise of 20 per cent. in the temperature of the flame; but this was sufficient to give 166 per cent. increase in the heat radiated. It is manifest, therefore, that much may be hoped from an introduction of the principles of regeneration with gas-stoves.

Mr. Siemens, who introduced the first practical form of regenerative lamp, also applied regeneration to gas-stoves, which are largely used on the Continent. In the gas-stoves made upon this principle, the gas is burnt in the upper part of the stove in a row of small isolated jets; and the products of combustion are led down through a pocket of sheet iron, in contact with the walls of which the air to supply the flame is made to pass. The heated air causes regeneration of the small flames, which give a

most brilliant light, and radiate a very large amount of heat, which, falling upon a suitable reflector, is directed over the floor and lower part of the room. The stove has thus the cheerful appearance which is one of the great charms of the open fire; while the heat is communicated to the apartment in the same way. The flames being out of contact with any cooling surface, combustion is complete, with the result that there is no carbon monoxide to leak through the metal sides, and the stove is absolutely free from smell.

Having obtained a large and small stove of this construction, I tested them under identically the same conditions as the English stoves. To my surprise, I found that the efficiency was nearly two-and-a-half times as great; the 200 cubic feet of gas consumed in the German stove giving a rise of temperature of 31° Fahr. as against the 13° Fahr. yielded by the best English stove with the same consumption of gas. Comparing this with bituminous coal, we find that 80 cubic feet of gas, or 2½ lbs., are equal to 35 lbs. of coal or one-fourteenth the weight. The coal, however, only costs one-tenth the price of the same weight of coal gas; so that, making allowance for this difference, coal gas is substantially cheaper than coal burnt in the ordinary form of grate, when regenerative gas-stoves are employed.

The introduction of the regenerative principle for lighting purposes practically increases threefold the amount of light obtainable; and it would appear probable that, when properly applied for heating purposes, an increase nearly as great may be obtained.

Regenerative stoves, moreover, made on the principle of those to which I have just referred, are free from many objections which militate against the ordinary form of stove; and the absorption of heat from the products of combustion is rendered so perfect that they can be discharged into the flue at a temperature of 200° Fahr. It is advisable, however, not to carry the cooling of the products to quite this point, as it leads to condensation of the water in the regenerating chambers, which have, therefore, to be fitted with syphon overflows to keep them clear. If the escaping gases are brought down to between 300° and 400° Fahr., no condensation takes place, and the temperature of the escaping products is sufficiently high to give a brisk draught in the chimney, and so make the stove almost as good a ventilating agent as an open fire.

As I before pointed out, it is unwise to attempt cooling the products of combustion from an ordinary gas-stove, because of the presence of carbon monoxide, which leaks through the iron plates; but wherever complete combustion of the gas can be ensured, the more the cooling of the products, the higher will be the heating efficiency.

I think that, at the present moment, a practically new factor in the combustion of coal gas has been introduced, which will mark an epoch in the consumption of gas for heating purposes. When we mix air with coal gas in a Bunsen burner, diffusion has practically no time to complete the admixture of air and gas in its passage up the tube to the point at which it is burnt. So that we are practically consuming small streams or layers of coal gas, which are side by side with similar layers of air; and, although the result is a certain acceleration of the combustion, that acceleration is very small compared with what could be obtained by other methods which would give complete admixture for combustion. In order to ensure the greatest intensity of heat which is entirely dependent upon the rapidity of combustion, we must have the particles of gas and the particles of air which are to enter into combination side by side; so that when ignition takes place, the particles can instantaneously combine without having to search for the body with which they have an affinity. In a blowpipe, we achieve a certain increase in temperature by blowing an excess of air under pressure into the centre of a gas-flame; the inrush of a larger quantity than is really needed rendering the combination of the particles of air and the particles of oxygen in the air more rapid. But such an arrangement has the drawback that, at the same time that you are putting in a large quantity of oxygen, you are increasing in four times that ratio the supply of inert nitrogen. This has to be heated to the same temperature as the flame, and cools it down to an enormous extent; the difference between the temperature of an ordinary atmospheric blowpipe and an oxy-gas blowpipe being due to this fact.

M. Denayrouze—an illustrious member of the French Gas Institute—having realized this fact, has made an atmospheric burner in which, after the gas and air are mingled in the ordinary way, they can be churned into a condition of complete admixture by a small fan driven at a high rate of speed, in a chamber situated a small distance below the point of combustion.* The effects which are gained by this process are really remarkable, and will enable us to obtain, from coal gas and air, temperatures far above those which we have before considered possible. The temperature of such a flame is so high that it is impossible to measure it by thermo-couples by the same method that we can employ with an ordinary Bunsen flame; and we have to rely upon the intensity of incandescence which it can produce in order to judge of the increase in its heating power. If we take an ordinary Welsbach burner and mantle, with the chimney on, in order to increase the uprush of air, it is stated that we obtain with London coal gas a light of 12·5 candles per cubic foot of gas consumed; but on using the same mantle with the Denayrouze burner and with London coal gas, we develop a light of not less than 27 candles per cubic foot of gas consumed, without the use of a chimney. In other words, the incandescence is more than doubled; and I have had burners in my London laboratory, which will consume 9 cubic feet of gas per hour, and give as much as 250 candle power.

I saw this burner first in Paris, where it was developing 25 candles per cubic foot of the Paris 14-candle gas. I was so surprised at the result, that I imagined I must have made some mistake in my translation from Carcels and litres to candles and cubic feet. So I induced M. Denayrouze to let me have some of the burners over at my London laboratory, where I found that not only were these results thoroughly confirmed, but that the increase in the quality of the gas augmented the light by 2 candles per cubic foot of gas consumed. It must be borne in mind, moreover, that this burner requires no chimney, and that the fan which does the mixing is driven by a small electric motor only requiring 0·25 ampère at 4 volts. The amount of electricity used is thus excessively small; and where electric power is not available, the fan would be quite as well driven by clockwork. The fan is used entirely to mix the gas and air, and is so arranged that the pressure at the burner is extremely low. It seems to me that the adoption of this principle, or some modification of it, may prove as great an advance in the efficiency of our consumption of gas for heating and cooking purposes as it undoubtedly will be in lighting.

In conclusion, I think that the gas manager must at the present moment feel certain that, instead of the gas industry being practically moribund, as our electric rivals would have us believe, it is really only in its infancy, and that the improvements in heating and lighting which the next quarter of a century will bring forth, will even eclipse the magnificent record of the past two decades.

Discussion.

The PRESIDENT said this had been a most interesting and valuable paper; and he hoped they would have a good discussion, so that the subject might be thoroughly threshed out.

Mr. DENNY LANE asked Professor Lewes if he thought the mantle of the new burner would last as long at the high temperature shown as at the lower one.

Professor LEWES said he had not had the mantle burning a sufficiently long period to say. He simply used it to demonstrate the temperature of the burner by the intense incandescence of the mantle.

Mr. NORTON H. HUMPHRYS (Salisbury) said he had been extremely interested in the explanation given by Professor Lewes of the Bunsen burner. It cleared away difficulties which he had noticed for some time past; and very possibly others who had to use these burners had observed the same thing. Sometimes in heating a crucible, one burner was found to be much better than another. For instance, he had one particular burner for this purpose which really seemed to give a much better result than any of the others; but he had never known why. This explanation, about the more perfect or better mixture of the air and gas, seemed to clear the matter up. The question he wanted now to ask was with regard to the flame. It was pointed out that, in the ordinary Bunsen burner, the gas and air burnt side by side; and that, by

* For an illustrated description of this burner, see our "Register of Patents" for June 11 last, p. 1256.—ED. J.G.L.

getting a better mixture, a better result was obtained. He (Mr. Humphrys) would ask whether the combustion was incomplete in the ordinary burner, and whether some of the better effect obtained was not due to more complete and better combustion?

Mr. T. N. Ritson (Kendal) desired to thank Professor Lewes for his admirable paper, which had brought up an old subject in altogether a new fashion. He should be very glad indeed of further information with regard to the German stoves mentioned in the paper. He found that, with English-made stoves for bedrooms, the noise they emitted when burning was a very great drawback; and in many cases he had to take out gas-fires simply on account of the hissing noise. Anything which would obviate this objection would certainly be a step in the right direction. He had drawn the attention of stove-makers to the matter; but the objection still seemed to exist.

Mr. D. Bruce Peebles (Edinburgh) said he was much disappointed that his friend Dr. Ferguson, the respected head of the Edinburgh Institution, was not present that morning; because he, as a student at Heidelberg under Professor Bunsen, was the first to bring from Germany to Scotland a Bunsen burner. It would have interested him very much to have heard the admirable lecture given by Professor Lewes, and to have seen the experiments in which the Bunsen burner took such an important part. In connection with the use of gas in heating stoves, he should like to refer to one point—viz., the absorption of heat by the walls of houses, whereby an enormous amount of heat was wasted. For the last 18 or 20 years in his house, he had had a warming apparatus; and a good deal of fuel was used. But still they could not get hot water as readily as he liked. About a month or six weeks ago, he covered the tank in the upper storey of the house with felt; and the great economy and increase of heat resulting from the simple application of a non-conducting material was extraordinary. It occurred to him whether something of the same kind could not be tried for houses—whether it would not be an advantage to put a non-conducting material, such as slag wool or something of the kind—on the walls of the rooms, instead of the ordinary plaster, so as to reduce the absorption of heat.

Mr. W. Carr (Altrincham) asked if they might be allowed to see the flame of the French burner apart from the hood. He felt quite bewildered by the mass of information contained in Professor Lewes's paper and the lecture which had preceded it; and he was quite unable at the moment to discuss the former.

Mr. C. S. Ellery (Bath) said Professor Lewes's was a most important paper; and he thought there must be some practical outcome from it. There could not possibly be this large increased efficiency, where mechanical appliances were brought into play, without some effort being made to introduce them into stoves. He should like to ask Professor Lewes whether in some degree the same effect might not be brought about by lengthening the passage through which the gas and air had to travel. When the tube of a Bunsen burner was cut down too short—out of proportion to its area—the flame lit back, and there was incomplete combustion; and it occurred to him (Mr. Ellery) that, if the tube were lengthened considerably, the gas and air would have a longer travel, and the mixture might become more complete. They must all be pleased to see the possibilities of improved lighting as well as heating under these new conditions.

Mr. Stelfox said it was no doubt a most beautiful lamp. He assumed it was so arranged that, when the gas was turned off, the action of the motor also ceased.

Professor Lewes said that was so. The motor was arranged to be driven according to the pressure and quality of the gas.

Dr. Stevenson Macadam (Edinburgh) said that he had been greatly pleased with the paper, and in no important sense could he profess to hold different opinions to those which had been so clearly expressed by the author of it. He was very pleased indeed to find Professor Lewes had alluded so prominently, in the first part, to the necessity of having flues in all gas-stoves, whether for cooking or heating purposes. Every gas manager knew the necessity for this; but the popular mind still required to be educated. It was very common to find stoves introduced into the rooms of dwelling-houses—especially bedrooms—and no arrangement made for ventilation. Consequently, gas-stoves had a bad name. He had been very much interested in the light of the new lamp just shown. There appeared to be a decided advantage undoubtedly in the more thorough mode of mixing the air with the gas. Whether this result could be achieved by the method suggested by Mr. Ellery, he did not know; but there could be no doubt, from the appearance of the light and the records of Professor Lewes's experiments, that there was a great increase in the luminosity of the flame. At first, he (Dr. Macadam) was inclined to think that possibly there might be a great danger in mixing the air and gas together—provided, of course, there was a considerable gas and air space in the lamp—as there might be a tendency to explosion, especially if these lamps were placed in the hands of comparatively ignorant people in ordinary households. A large amount of new matter had been brought forward in Professor Lewes's paper, which would require very careful consideration; and the main object of such papers and discussions following thereon was to encourage research, and to obtain new facts. There was no doubt that Professor Lewes's interesting experiments must, in the long run, conduce directly and indirectly to great improvements being made in both lighting and heating by gas.

Mr. Alderman Miles (Bolton) said it would be impossible to speak in adequate terms of the way in which Professor Lewes did all his work; and therefore it ill became him to say that he felt a little disappointed on just one point. The Professor made a very pertinent and strong reference to the heating-stove introduced by Mr. Siemens in Germany, and had given an exhibition of the Welsbach light. But they would have been delighted to see the stove referred to; for it seemed to him that in that stove, if it were going to be a commercial success (as he had no doubt it would be), they, as gas managers, were going to reach the millennium so far as heating by gas was concerned. It appeared to him a marvellous statement to make; and its far-reaching character could easily be understood when they heard from Professor Lewes that a stove had been introduced which would be practically as economical as coal. When such a thing was introduced into England, there was bound to be a revolution in the heating of rooms. He should like to know whether there was a likelihood of seeing this stove actually in work within eighteen months or two years; for he was sure it would be hailed by gas managers with the utmost cordiality.

Mr. Denny Lane said if 15 or 20 feet of gas per hour were consumed in an ordinary burner at the height of 6 or 7 feet above the floor of a room, no inconvenience was found to arise, provided there was sufficient ventilation; and he should like to know if they had gas-stoves carrying their flues within the room, and delivering the products of combustion at the height of 7 or 8 feet above the floor, whether that would not do away with the necessity for having the flues connected with the external atmosphere. Unless there was some difference in the products of combustion, it appeared to him that, if they were evolved at the same height as they were in the ordinary lighting arrangements, the inconvenience would be in a great measure got rid of.

Professor Lewes, in reply, said that Mr. Humphrys had opened the discussion by some very pertinent remarks on the Bunsen burner. He asked really what difference the perfect mixing of the gas and air made in the flame. Suppose they took an ordinary Bunsen burner flame, Mr. Humphrys asked: Did the imperfect mixing bring about imperfect combustion? No; it really brought about a great length of travel before the combustion was completed. If one took the imperfect mixture, it would be found that the flame was 6 to 7 inches in length before one got the constituents of the coal gas and the oxygen of the air, with their strong affinities, discovering each other, and getting duly "wedded" into the products of combustion. But the difficulty which they experienced merely lengthened the flame, and did not in reality affect the ultimate combustion. Do away with this difficulty; bring about a thorough admixture by means of a small fan rotating at a high speed; and the flame would be found to be at once shortened down to nearly half the size. There was the great secret in the increase of temperature—the longer the flame, the greater the dissipation of heat. It was intensified both by increasing the rapidity and decreasing the size; and for this an enormous increase in the heating effect was obtained. In the ordinary burner, this admixture took place imperfectly; and he (Professor

Lewes) was not at all sanguine of increasing the mixing by increasing the length of tube. There were one or two points upon which they were a little hazy; and chief of them all was that wonderful law of the diffusion of gases. They had all been taught that gases diffused into one another inversely as the square roots of their densities. But that was a purely proportional function, which did not tell one anything about the absolute rate. They often thought it possible to pass gas into a holder, and for diffusion to do an enormous amount of work in a very small amount of time. He had had this idea upset on many occasions. If one took a small holder and put in two gases of different densities, they would mix fairly quickly; but increase the holder to double the size, and the diffusion would take—not double the time, but six times as long. Increase the holder until it reached a half-million size; and everyone knew there would be a layer of dead gas at the top after perhaps six weeks with the holder going up and down all the time. In this case, the diffusion in some unaccountable way had ceased to be that rapid factor in mixing the gas that they were apt to reckon upon. In sending any gas through a Bunsen burner, it was manifest that the gas and air must pass in at different rates of flow. That was manifest because the air was under ordinary atmospheric pressure, and the gas under a pressure of 1 inch or 1½ inches, and being delivered through a small orifice. There was, therefore, a distinct rush of gas, and a slow flow of air round it. But when one had two sets of molecules—one moving at one pace, and the other set moving at another—it was much more difficult to bring about the diffusion which would lead to complete mixture. When he first saw the Denayrouze burner, he had an idea that it would be possible to utilize the rush of gas in the burner itself to run a little fan to work a motor which would mix the gas and air. But on trying experiments on this point, it had been found that the rapidity of mixing was not sufficient to complete it. The quicker the motor travelled, up to a certain point, the more perfect the mixture, and the more perfect the result. He did not think there would be any danger of explosion for this class of burner. With regard to stoves of the regenerative type being introduced within two years, he did not know how long they had been introduced into Germany and Austria; but he thought he had seen them in certain parts of Austria for two years at least, and perhaps more. It was seeing them, and noticing the wonderful amount of heat coming out of the reflecting surface, that attracted his attention. When he first saw them, he thought it was the old form of luminous-flame stove. Then he noticed that from the reflecting surface there was a great deal more heat coming than was obtained under ordinary conditions; and, on looking into the matter, he found that they were regenerative stoves. He thereupon obtained the samples which he had tested. He did not think there were any on sale in England; but there was not the slightest difficulty about getting them or making them. His hope certainly was that if the German manufacturer could make a stove of this efficiency, the English manufacturer would not be very long before he also did it. The first point was to bring out the fact that efficiency could be increased in this way. Mr. Denny Lane's question immediately afterwards would suggest that point. If there were a cluster of flat-flame burners just above one's head, no trouble was experienced from the heat. But if there was a big Wenham or any other form of regenerative burner just above the head, a distinct cause of oppression and heat would be felt. With regard to Mr. Lane's question, as to the possibility of doing away with flues if the products were discharged into the air above a height of 6 feet, his advice was: Do not do anything to keep alive the idea that a flue could be dispensed with. There must be a flue, because with ordinary stoves the gas-flames were burning, and not giving complete combustion. Directly the flames were interfered with, there was incomplete combustion, which played havoc with health. Of course, if regenerator burners were used, in which complete combustion was taking place, and the products were nothing but carbon dioxide and water, these could be allowed to go into the room above a certain level, and there would only be the same amount of oppression as if the same amount of gas were burning from open burners. But as there were very few English stoves which did this, he did not think it advisable to give any colour to the idea that it was safe to do without the flue. [Professor Lewes then proceeded to explain further the action of the lamp by first stopping the motor, to show that the mixing of the air and gas was not going on. A much longer flame was thereby produced. He then removed the mantle so as to show the difference between the burner without the fan and with it. On increasing the rate of the motor, the flame became shorter, and of much greater intensity.]

Dr. Macadam asked if, when the light was burning in this way, there was any tendency to strike-back.

Professor Lewes said the rate of the motor was regulated so as to give a mixture just above the point at which it would strike-back; all chance of this being, however, prevented by the form of the burner, and by a guard of wire gauze.

THE TRANSFER OF GAS AND WATER UNDERTAKINGS TO PUBLIC AUTHORITIES.

By William Newbigging, of Manchester.

It may be thought by some that, as this is an institution of gas engineers, any mention of matters relating to water is out of place. But, as you are well aware, many of the members of the Institute are engineers, managers, and secretaries, and, in the case of a few fortunate ones, even shareholders and directors, of joint gas and water undertakings. Furthermore, as an advocate of the gas and water works wherever practicable—and especially in towns of moderate size—being under one and the same management, I think I need hardly make any apology for coupling the two together in the paper which I have the honour and pleasure to submit to you.

The advisability of a local authority acquiring the undertaking of a water company is rarely questioned, even if the amount to be paid for the concern is a somewhat onerous one; and when it is considered that to every person water is a prime necessity, and that to a large extent the health of a community depends on a pure and bountiful supply of that commodity, it is not to be wondered at. About the acquisition of a gas undertaking, there is considerably less unanimity of opinion; though it will be conceded that a supply of gas for lighting, heating, cooking, and motive power purposes, at a reasonable rate of charge, is only second in importance to a supply of cheap and pure water.

A public authority having allowed a company to "bear the burden and heat of the day," in the shape of the risks which are run when establishing and working up a new business, and seeing with a jealous eye the success of the company, begin to ask themselves the question—"Why should we not acquire the undertaking, and appropriate the profits in relief of the rates, or in a substantial reduction in the prices?" A praiseworthy inspiration no doubt, but one requiring careful consideration.

Having instructed their officers to prepare a statement giving the particulars of the working and cost of similar undertakings to their own which have been so transferred, they are apt to feel astonishment at the amounts that have been paid to the companies owning such works. After some consideration, however, their astonishment gives way somewhat, and they begin to take a reasonable view of the matter. They remember that the company has had granted (or should have had granted, if those in charge of the undertaking have exercised foresight) statutory powers from Parliament, giving it practical immunity from competition. They also remember that, during the years of trade depression, the company has not only been able to keep its head above water, but whilst other trading concerns were sinking round about, it has been paying substantial dividends, and the business has been a constantly growing one.

Looking back on the career of gas and water undertakings generally, they have nearly all been successful; and the promise of the future, except to a few timid shareholders—and those without a real knowledge of things—is to-day as bright as, if not brighter than, ever it has been. Hence it is easy to understand that, in nine cases out of ten, shareholders in a gas or water undertaking are reluctant to dispose of their property; and they are the more reluctant now-a-days when it is so difficult to find a safe security yielding a return anything like equal to the dividends they are receiving from their present investment. The shareholders are quite willing to let well alone; and, whilst satisfactorily fulfilling their

statutory obligations, to rest content in the knowledge that they are in possession of a thoroughly sound security. However, if the public authority of the district in which the undertaking is established seem determined to acquire the property—and the newly formed District Councils are bestirring themselves in this direction—it behoves those in charge of gas and water undertakings to put themselves in a position to enable them to state on what terms they are willing to dispose of their property.

Whether the undertaking is gas or water, the principle adopted of arriving at the commercial value is the same. With a statutory undertaking, the maximum dividends allowed under the company's Special Act on the called-up capital, are taken as a basis; and these are multiplied by a certain number of years' purchase. In the case of a non-statutory company, the average maintainable yearly profits are taken; and these are usually such as appear in the latest published year's accounts. Of course, if anything should have occurred of an exceptional nature during the year—whether in the shape of an unusual increase or decrease in the price of coal, or an expensive lawsuit, or any other similar but abnormal occurrence—this should be taken into consideration, and a deduction or addition made as the case may be, until the fair maintainable profits of the year are arrived at. Having ascertained the amount of the maximum dividends, or the year's profits, as the case may be, it is necessary to answer the question which naturally arises: Is the undertaking in a condition to maintain these profits? This necessitates an inspection of the works by one qualified to give an opinion.

It sometimes happens that a public authority and a company are able to agree on the amount of the purchase-money; and to an outsider this seems to be very desirable. But it is not always as desirable as it appears on the surface, looking at it either from the seller's or the purchaser's point of view. When a transfer at an agreed price takes place, the public authorities are apt to find themselves saddled with a works which, in addition to having cost them a large sum, require an immediate outlay for plant to meet the demand for gas or water as the case may be. On the other hand, when a thorough investigation has been made—and it is here that the advantage of a reference to arbitration shows itself—the condition of the undertaking as a whole, and the state of the producing and distributing plant, as well as the financial details, are thoroughly inquired into; and any deficiencies are brought to light and allowed for in calculating the value of the undertaking. Then, again, when the plant is found to be largely in excess of general requirements, and there is a prospective value to be taken into account, an addition is made to the calculated prices. Nothing should be taken for granted, as is often the case when a lump sum is agreed on. A reference to arbitration is generally the cheapest in the long run, even when the cost of such reference has to be paid.

Having arrived at the fair maintainable profits, or the maximum dividends, it is necessary to determine the number of years' purchase which should be asked for an undertaking. I have purposely avoided giving a table of the number of years adopted in the case of transfers that have taken place of recent years, as such a table might be more misleading than otherwise. Suffice it to say that, for statutory companies, they range from 25 to 30 years in the case of gas, and as high as 33 years in the case of water. For non-statutory gas and water undertakings, the number of years ranges from 20 to 25, according to circumstances. It will readily be granted that a statutory undertaking, being a more stable investment, is able, and ought, to command a higher price than a non-statutory company. In past times, the average number of years' purchase was less; but owing to the cheapness of money, and the consequently greater difficulty of finding another equally good and profitable investment, the number of years' purchase has risen considerably. Now, by multiplying the yearly profits, or the maximum dividends, by the number of years' purchase, the commercial value of the undertaking is ascertained.

The winding-up expenses are paid by the purchasers. If a reserve fund has been accumulated, it is retained by the vendors, unless otherwise agreed. The responsibility for the repayment of borrowed capital, when the interest is made a deduction from the profits, is assumed by the purchasing authority. The value of the stock-in-trade—such as gas, coal, tar and liquor, fire-clay goods, and other stores, in the case of a gas undertaking, and of water in stock, coal, and general stores in the case of a water undertaking—usually taken over by the purchasers at a price fixed by valuation, is in addition to the amount of the umpire's award.

A compulsory purchase clause in a Special Act is assumed to add about 10 per cent. to the ascertained value. Seeing that the amount of the umpire's or arbitrator's award is not given in detail, but a lump sum is stated, it is impossible to know—unless one is actually the umpire or one of the arbitrators—what is in their minds when making an award. So that it is not always possible to determine whether any sums claimed by way of additions for compulsory purchase, winding-up expenses, and compensation to officers, are included in the award. In such event, the amount of the latter item is left to the generosity of the shareholders.

Such is, in brief outline, the *modus operandi* of arriving at the commercial value of a gas or water undertaking. It should be borne in mind, however, that an accurate estimate demands a careful inquiry; and it is well, before venturing to negotiate, to seek the advice of those whose long and varied experience enables them to advise on the best course to pursue.

The purchasers of such works are, of course, the public authorities, as representing the ratepayers; and they are naturally anxious to pay as small a sum as possible for the undertaking. If it is a water undertaking, there is not so much to pick at as is the case with a gas undertaking; and the state of the works, with a hint or two that the purity of the water is not all that it might be, that an immediate expenditure is necessary, together with any financial misdoings, are about the sum-total of the statements made to depreciate the value of the concern. A gas undertaking has usually to bear the brunt of a much more severe attack. Added to the charges above mentioned, it is pointed out that, since the electric light came more generally into use, it has had the effect of lowering the market value of the shares, and consequently the total value of the undertaking; also that the recent improvements made in oil-lamps, and the greater cheapness of oil, have made this a more formidable rival than before; and that the fact of the profits depending to a great extent on the price of coal, and that in recent years the price of labour has increased, the profits are not likely to be as much in the future as in the past. Such, as a rule, are the arguments used to depreciate the value of the undertaking; and it is necessary to refute them.

Has the electric light in any single instance been detrimental to the interests of a gas company? On the contrary, it has stimulated the gas companies to greater efforts; and they have increased their consumption in directions which at one time were hardly dreamt of. I refer more particularly to the increased consumption of gas in the daytime, and for the hundred and one purposes to which gas is applied, and may now be said to be indispensable. No; the electric light may in some instances have caused the market price of the shares to droop a little, but it has in no way altered the real, substantial value of a well-managed gas concern. The recent improvements in oil-lamps (and they were much needed) are to be commended; but the advantage that oil possessed—in that people were able to pay for it as they used it—has been counterbalanced by the introduction of prepayment meters. The enormous demand for these is a proof that people prefer gas to oil, if they can pay for it by small instalments. So much for oil. As regards the price of coal, and the labour question, these are factors which influence the success of every undertaking, whether railway, gas, or electric light. All these statements are brought forward with a view to reducing the value.

A concern burdened with a heavy capital, on which maximum dividends are being paid, is not able to sell gas or water as cheaply as one with a smaller capital; and it is the possibility of being in a position to lower the price, amongst other reasons, that tempts a public authority to take steps to acquire such an undertaking. They know that the cheapness of these necessaries—gas and water—is an aid to the prosperity of the town, as it induces people to come to the neighbourhood, not only to reside, but to establish various works where the cheapness of gas and water is a *sine quâ non*.

Many men, acting as the representatives of the public, hesitate to take the responsibility of investing a large

amount of money in a gas undertaking, which, however differently we may think, they consider more or less speculative. And thus many undertakings which ten years ago could have been acquired for a comparatively small sum, have doubled in size, and the possibility of their being taken over by the public authority is more remote than ever.

In a case of this kind (and I know several such), it may be suggested that steps might be taken to acquire the distributing portion of the undertaking; the company retaining possession of the works up to the inlet of the governor—the governor and all the distributing plant forward to the inlet of the consumers' meters, to be in the hands of the public authorities themselves. The amount to be invested would not then be as large as if the whole undertaking were taken over. A price would be fixed for (say) 16-candle gas. If the public authority wished to have gas of a higher illuminating power, then the company to supply it at a proportionately higher price. A laboratory and photometer room would be established at the works, near to the outlet from the governor. This room would be under the control of a competent examiner, whose salary would be jointly paid by the gas company and the public authority, and whose reports as to the quality of the gas supplied by the Company would be accepted as conclusive. He would have no control over either the manufacture or distribution. I need not elaborate such an arrangement. I know well the objections to it; but they are not insuperable. It would at least give the public authority that which they are so anxious to obtain—viz., exclusive control of the breaking-up of the streets, the purity, and the illuminating power of the gas. The gas company, freed from the expense of collecting accounts, and the outdoor work generally, would supply the gas in bulk at a price agreed on, leaving the rate charged to the consumers to be fixed by the authorities. If, in course of time, the latter, having gained confidence and the requisite knowledge, decided to become manufacturers of gas, as well as distributors and purveyors, a sale and purchase of the manufacturing part of the undertaking could be arranged.

Discussion.

Mr. J. Hepworth (Edinburgh) said that everyone would be glad to see Mr. Newbigging following in the steps of his father; and he hoped that both their names would in future frequently appear in the Institute's "Transactions." He could not help thinking that a good deal of the father's wisdom was condensed in the son's paper. The case had been very fairly stated indeed with regard to what should happen when there was a transfer. A good many present probably were not anxious to see such transfers; but these things were sometimes forced on their notice. It was well, therefore, at all events, to be forearmed; and anyone having read this paper would be informed as to the method which ought to be adopted when a transfer was under consideration. It was very desirable in all such cases that proper advice should be sought—no doubt they would all agree with that assertion; but he did know of two instances (one a year or two ago) where a works was actually agreed to be sold for what any competent person would have said was at least £10,000 to £15,000 below its value. In this case, if the company had but consulted those who really knew what the value of their concern was, they would not have made such a glaring mistake. But it might be, although it was not so likely to occur, that the mistake would have been the other way; and the public authority might have been, by the absence of information, induced to pay a larger sum than the value of the undertaking. There was, therefore, great value in the suggestion made by Mr. Newbigging, that a competent opinion should be sought before any transfer took place. With reference to the last paragraph in the paper, in which it was suggested that they might perhaps some day come to an arrangement whereby a gas company should be the wholesale manufacturers, and the local authority the retail dealers—though he feared the local authorities would scarcely feel complimented by the suggestion—he thought they would hardly like to assume the humble position of being merely distributors of gas. He did not want to see this suggestion take shape, for the reason that at present those who had to do with gas undertakings and gas companies had quite sufficient difficulties with the local authorities; and he thought that these would be magnified (and could not be lessened) under such an arrangement. He feared it would lead to a constant source of irritation. But there was another and more important question than the comfort of the engineer involved. What would be the ultimate value of the undertaking when the works as well as the distributing plant were eventually severed? He could imagine what Mr. Newbigging's answer would be—namely (that given in the former part of the paper), that it should be so many years' purchase of the profits or dividends. But he feared that, when making an estimate of the value of an undertaking after it had been thus severed, there would be a very great divergence of opinion as to its value; and an arrangement of this kind would not work well from that point of view. A great deal of responsibility, in his opinion, attached to engineers who had acted in recent years in arriving at the value of gas undertakings. He had in his mind certain members of the profession who had in a most unaccountable way depreciated the value of a gas undertaking in the interest, of course, of the clients by whom they had been retained. He could not understand how a man who was imbued with the right view of the value of the class of property by which he earned an honourable living, could persistently try to depreciate the value of the undertaking in the eyes of others. It led to this, that, when the parties came to an arbitration (or rather before that), the public authorities had such a poor conception of the value of the undertaking that, when the works came to be transferred, there was universal heartburning or disappointment because the award was so large. This had arisen solely because the persons who were consulted by the local authorities advised them so injudiciously, and so persistently depreciated the value of the undertaking, that it became most difficult either for the engineers on the other side, or for the persons for whom they acted, to get them into a reasonable attitude again. This had led to an innovation in this year's legislation. There had been two or three Bills in Parliament this year with reference to the transfer of gas and water undertakings (but especially gas) in which a clause had been inserted—for the first time he believed—to the effect that the undertaking should be purchased by the local authority as an undertaking to be purchased by agreement, and not under compulsion. Another clause had been introduced, that the stock-in-trade should be classed as part of the undertaking. Again reference was made to the expense of the transfer; and there had been an attempt even to put this expense on the person who was disposing of his property, and doing it unwillingly. He (Mr. Hepworth) was glad to see that these clauses had been very successfully fought in the present session; but he did not know whether they would be fought so successfully next year. As yet no Bill (so far as he knew) had been passed containing these injurious clauses. He hoped the paper would prove useful in giving information on these points, and put gas managers on their guard against depreciating their property unduly.

Mr. Herbert Lees (Hexham) said one or two difficulties occurred to him with regard to the suggestion for transferring the distributive portion of the works to the local authority and the retention of the manufacture by the company. It would require two managements; and in a large proportion of works, two managements would mean a less salary and presumably an inferior class of management. With regard to the breaking-up of streets, he was not quite sure that the greatest friction occurred where the streets were under the control of the gas company; and it was quite possible that there might be as much friction between two departments of the local authority as between the gas company and the local authority. He had places in his mind where such diversities of opinion prevailed. Then came the question of reducing the price of gas, with the view to increasing the consumption; and difficulties would likely arise there in this way. The company would retain its profits on the manufacture; and the local authority would have its profit from the price it charged over what it paid. But there would still be the power on the part of the local authority that there was now, to transfer a considerable amount from the rates to the profits; and this would necessarily keep up the price of gas, and prevent that increase of consumption which reductions in price might bring about. The company would have no control over such a proceeding; and consequently the consumption would be kept down. When the whole works was under one control, he thought, these

matters could be much better arranged; and there would be a greater incentive to please and educate the consumers, and to increase the consumption of gas.

Mr. J. Stelfox (Belfast) said the author had not given any definite opinion as to the desirability of these transfers taking place, but had rather confined himself to the methods to be observed in case of such transfer occurring. There had always been a considerable doubt in his (Mr. Stelfox's) mind whether, after all, corporations were the right parties to conduct manufacturing industries. The openness of the committee in many ways—especially when there were many persons who took pains to find out what was going on—was often a great obstacle; and there were very few businesses which could be conducted with the publicity given to proceedings in committees. He had at times told some of his friends that, if they had to go down to sell their linen with the lowest price they were prepared to take (on an emergency) displayed on the front of their hats, there would be very little advantage in going on 'Change. There were certain advantages in corporations having gas-works. The main one was that they could borrow money cheaply; and in most corporations the amount standing against them for interest was very low as compared with the dividends required to be paid to shareholders in companies. That was the principal inducement to a corporation to undertake the acquisition of gas-works; and any such inducement would be completely lost if Mr. Newbigging's suggestion were adopted, of the manufacture being continued by the company, and the distribution taken over by the corporation. On the other hand, there was this objection to corporations: Mr. Newbigging spoke of the desire for pure water and pure gas; but he (Mr. Stelfox) was afraid that corporation gas was sometimes adulterated with politics, which it was much better to keep out of any manufacturing concern. At the same time, there could be no doubt that, seeing that money could be had so much more cheaply by a corporation, there would always be an inducement to acquire these undertakings. With regard to the services of a consulting engineer being obtained, he thought they were very useful if they could only assume the standard Mr. Hepworth had set up. In such cases, a consulting engineer should not be necessarily a partisan, but go in for fairly ascertaining the value—not being retained (as solicitors usually were retained) to make the very best case they could for their clients, irrespective of the justness of their claims.

Mr. Alderman Miles (Bolton) said he understood Mr. Newbigging to say that, in his opinion, fewer transfers from gas companies to corporations would be made in the future than in the past; and in that opinion he (Alderman Miles) entirely agreed. He had noticed a disposition on the part of local authorities of late years to "fight shy" of taking over gas undertakings, for more than one reason—mainly, he thought, because they were very strongly imbued with the idea that electricity would supersede gas. As to whether it was desirable for a local authority to take over the works of a gas company, that was a matter on which there would always be differences of opinion. Having had experience in both capacities, he thought it was a good thing for the community at large, generally speaking, to take over the works of gas companies. In his experience, in a town where the works were under the old company and they had taken a portion of land for extensions immediately contiguous to the public park of the town, and there began to erect some immense gasholders, there was a great outcry from the inhabitants; and public meetings were held against the outrageous conduct of the company. They all knew the friction which was going on between gas companies and local authorities with regard to the breaking-up of streets. Now immediately upon the transfer of the gas company to the corporation, the corporation set about completing the extension of works near the public park; and not a single word of complaint was heard from any portion of the inhabitants. It had been said that practically there might be a considerable amount of friction between the various departments of a local authority with regard to the opening of streets; and he was disposed to agree with that. But it was remarkable, when they knew that the gas-works belonged to the town, how careful they were to avoid making any public outcry about them. All these difficulties were kept rigorously confined to the four walls of the committee-room. The gas-works with which he was acquainted—which were acquired something like 22 years ago from a company—had given in relief of the district rates a sum equal to £200,000 out of their profits. It might be said: "But what had the price of gas been all this time, or what would it have been if the works had been in the hands of the old company?" He believed he was right in saying that the price of gas, and the arrangement of the works, were equally well-managed under the corporation as they were under the company; and instead of the shareholders who only formed a small portion of the community being benefited to the tune of £200,000, the money had gone into the hands of the ratepayers at large. He did not know that, if he were a gas manager at the present moment, he should wish to be transferred from a company to a corporation. He had seen cases, much to his regret, where, the moment the transfer had been made, the manager's or engineer's life had been made anything but pleasant; and this was one of the worst features of corporation management. The members of the corporation, on committee, thought they had a perfect right to attack public servants on every conceivable opportunity, and sometimes without just cause. But still, on the whole, he thought where the works were transferred, it would be an advantage to the general public—not that he expected to see many such transfers in the future. Gas property was now in such a prosperous condition as he had never known it in his experience; proving clearly that the works were generally well managed, and a sound and good property.

Mr. Newbigging, in reply, said he was pleased with the criticisms which had been passed on his paper. In writing it, he had simply stated such facts as he thought would be of use and interest to those who had had no practical experience of such transfers. Whether transfers of this character were a benefit to the public generally was somewhat beyond the province of the paper; and on that point he had not expressed any decided opinion. But he might say that, judging by the success which had attended the working of concerns so transferred during the past ten or fifteen years, they had in the majority of cases benefited in a pecuniary sense. It was, however, very questionable whether they had altered their position at all as regards improved lighting. In this respect, the companies, with very few exceptions, were satisfactorily fulfilling their obligations. Some of the points raised by the various speakers were deserving of a much better answer than could be given in a merely impromptu reply. He had, however, quite sufficient material out of which to form another paper; and this he hoped to have the pleasure of putting before the Institute on another occasion. As one of the younger members of the Institute, he had cheerfully responded to the invitation of the Council to prepare a paper; and he need hardly say how highly he appreciated the honour.

The Association of Gas Engineers of Austria-Hungary.—The fourteenth ordinary general meeting of this Association was held on the 24th and 25th of May, at Salzburg, under the presidency of Herr C. Bauer, of Vienna. In the absence of the Mayor, the members were welcomed to Salzburg by his deputy, Herr Mayer. The post of Treasurer, rendered vacant during the year by the death of Herr G. Grotz, had been filled by Herr Göhring, whose place on the Committee was taken by Herr Kelsen. These appointments were confirmed for the ensuing year; and the three retiring members of the Committee, as well as the Auditors, were re-elected. It was decided that next year's general meeting should be held at Buda-Pesth. Thanks to the able editorship of Herr M. R. von Pichler, seconded by the exertions of the publisher, Herr O. Mohrstedt, the *Gastechniker* (the official organ of the Association) brought in a small, but satisfactory profit. Herr Nachtsheim, of Vienna, who is the Honorary President of the Association, in his introductory address, reviewed the progress of the gas industry, and the more recent applications of gas. He was followed by Herr F. Lux, who gave an interesting address on "Acetylene;" showing, in a small experimental plant, the production of the gas from calcium carbide. Herr Nachtsheim then read a paper on "Gas Tramways;" referring especially to the Dessau installation, which has proved so marked a success. Cooking by gas received attention at the hands of Herren C. F. Schweickhart and F. Horadam, who exhibited the appliances of their respective firms—the Water, Lighting, and Heating Company of Vienna, and Messrs. F. Siemens and Co. Herr Blum, of Berlin, made an interesting communication on a new gas-hammer and Reuther's condenser. A prize of 100 florins was awarded to Herr Nachtsheim for his paper on the "Gas Tramway." It was decided to include in future the current topics of water supply in the proceedings of the Association; and the meeting then closed with a vote of thanks to the President.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 49.)

Business on the Stock Exchange during the past week was, on the whole, rather quiet; and despite some little tendency to irregularity at times, prices ruled firm almost throughout the list. One of the most noteworthy things is the pace at which all first-class stuff is being forced up; and the movement is thoroughly genuine, owing to the impossibility of employing money elsewhere. Consols were done at 107½ *ex div.* on Thursday—a record price, but one which is not likely to remain a record long. Home, Colonial, and American rails rose freely; and the Foreign Market did pretty well. The change of Government at home seems to have made a good impression. The Money Market was but little affected by the settlement, which operation was got through without inconvenience. In the Gas Market, transactions were decidedly below the average; and on some days things were very quiet indeed. There was a marked tendency to rise in price; and, in one or two instances, the upward movement was accentuated to a remarkable degree. Gaslight "A" opened rather sluggish at first, and changed hands at 277½. But it rapidly developed great buoyancy, and rose by big steps, until on Saturday it took a jump up to 290—a difference of no less than 12½ between the opening and closing prices. Not much was done in the secured issues; but anything offering was readily taken at nice figures—the debenture stock being especially good. There was very little business done in South Metropolitans; but it is interesting to note that on Wednesday the "B" was at 301½—a price which returns about £3 19s. 8d. for money. It is a new "record" for the ordinary stock of a Gas Company to beat a 4 per cent. price. Nothing was marked in Commercials. The new stock was inadvertently put down on Wednesday; but the erratum was corrected the next day. Suburbans and Provincials changed hands but little, as usual. But prices were very good; and Brentfords marked a substantial rise. The Continental Companies were more than usually inactive; but Union made a considerable advance in price. Among the rest, Bombay and Melbourne were the only ones to vary. The Water Companies were for the most part quiet; but almost every one had a considerable rise in quotation.

The daily operations were: Gas opened unchanged on Monday, and remained without much sign during the day. New River Water rose 5. Tuesday also was a quiet day; but Gaslight "A" advanced 3. East London Water was ½ higher. There was even less doing on Wednesday. But the tendency was all on the rise; and Continental Union improved 5. In Water, East London and West Middlesex gained 3 each. Thursday's business was mostly in Gaslights; and the "A" rose 2. On Friday, transactions in Gas were at their lowest—only three bargains being marked; but Gaslight "A" and each Brentford issue advanced 3. In Water, New River improved 5. Saturday was quite active; and prices were excellent. Gaslight "A" rose 2; Melbourne bonds, 1. In Water, Lambeth advanced 2½; and East London and West Middlesex, 2 each.

ELECTRIC LIGHTING MEMORANDA.

A Combined Electrical and Water Supply Undertaking—Destruction by Fire of the Sardinia Street Supply Station—Electric Lighting in the City of London—A Question of Interpretation.

As an illustration of the desire of electric lighting engineers to discover a practicable way of supporting a central electric lighting station by some auxiliary business, a paper recently read at Cologne by Herr Luhn, upon a combined water supply and electric lighting installation recently put in operation at the village of St. Lazarus, near Posen, is not without interest. It appears that the inhabitants of this district (numbering 3000) wanted a better supply of drinking water than their private wells afforded; and this was found on a spare piece of public land. Thereupon it seems to have occurred to somebody that an electric lighting plant could be tacked on to the water pumping station; and this was accordingly done after a highly ingenious and most scientific plan by which steam power sometimes pumps water, and sometimes drives a dynamo and charges a battery of accumulators, which again are capable at a pinch of pumping water, actuating a set of air compressors to give more head to the water supply in case of fire, or keeping incandescent lamps going when the main engine is not working. The streets are lighted by arc lamps; and everything is highly satisfactory—to the electrical engineers and contractors who carried out the work. Fortunately, in the nick of time, a large customer for water was secured in the Railway Company; and since then the sale of water has covered the entire cost of working. This is very lucky for the villagers, since the electrical portion of the combined installation cost £3750 out of a total expenditure of £5000. How long the water consumers will remain content to pay the bill for everything, remains to be seen; but the bare statement of the facts is instructive as illustrating how matters are likely to stand when electric supply is combined with another enterprise.

On the evening of Monday last week a destructive fire broke out in the Sardinia Street station of the Metropolitan Electric Supply Company, when the generating plant and distributing connections were totally destroyed. The premises consisted of a large building of several stories; and the fire broke out with great violence somewhere in the upper portion, and defied all efforts to deal with it. With the usual malignity of Fate, the mischief happened just as the plant was being made ready for the evening's work, which comprised the lighting of a large number of places of public entertainment, hotels, restaurants, and clubs in the West End. It is stated that, although the general supply of current from the station was stopped in consequence of the fire, the interruption was only of a few hours' duration, owing to the Company's system of trunk mains, which enables the various stations to help each other in time of need. Unfortunately, however, the local connections being destroyed, it was impossible to immediately connect up all the distributing mains; and it was half-past eight o'clock before the theatres and other of the most important consumers in the neighbourhood of the Strand were lighted as usual. Others had to wait until next day. Accidents will happen; and it would be unfair to exaggerate the importance of this disaster. But, for all that, it would not be surprising if the occurrence were to induce some of the inconvenienced consumers to reconsider their lighting arrangements. If the present breakdown at Sardinia Street had occurred two or three hours later in the evening, the annoyance to the public would have been far greater, and might not have been without an element of danger.

The City of London Commissioners of Sewers have decided to carry out the experimental street lighting mentioned in this column last week, at a cost of £386. At the same time, they directed their Streets Committee to consider the desirability of experimenting also with incandescent gas-lamps. It is not too much to expect that every possible discouragement which the electrical party in the Commission can bring to bear upon the Committee, will be applied to prevent this direction from having any practical effect. It is something, however, that the Commission have been prevailed upon to recognize the fact that the last word has not been said for gas in connection with street lighting. Plenty of experimental proof has already been given that, for a very small additional outlay, the gas lighting of the City of London might have been greatly improved. But the local Electric Lighting Company was the child of the Mansion House; and although the period of gestation was remarkably prolonged in this case, there is reason to surmise that some of the civic nurses made a good thing out of the happy event when it did come off. So we do not hope to see the incandescent gas-burner taken further notice of by the Streets Committee. The recent debate on the subject of the further electrical experiment furnished an opportunity for a member of the Commission to draw attention to the circumstance that the City is paying £12,500 for the electric light, as compared with £4464 for gas under the old system. And yet there are rumours that the Electric Lighting Company are not happy.

As was expected would be the case, faults are being found with the proposed new Board of Trade regulations for electric supplies. It is complained that the use of small arc lamps for lighting shop exteriors will be prejudiced by the requirement that all such lights shall be suspended at a height of not less than 10 feet from the ground. The employment of this description of arc lights for the purpose named is stated to be increasing, on account of their superiority in regard to economy and effectiveness to the large incandescent electric lamps which are also used for the same purpose. The question here depends upon what is meant by the term "small" in connection with arc lamps. Many attempts have been made, without permanently good results, to reduce the size of arc lamps so that they shall only give the light of 100 candles or so. Such lamps might without inconvenience to the public be used in front of shop windows, in proper screened lanterns, at a less height than 10 feet from the pavement. But if by a "small" arc lamp a light source of what is called in the trade 1200-candle power is intended, there is good reason for the proposed regulation. It is further complained that the requirement that arc lamps are not to be used "in situations where there is any danger of the presence of explosive dust or gas" might be interpreted to prevent their employment in many factories and interiors, as well as wherever gas is also used. This is rather a straining of the point; because it can hardly be the intention of the Board of Trade to forbid the companionship of electric arc lamps and gas-burners in the same building. It will be as well, however, to have the matter cleared up; since experience shows that the official mind is prone to take official regulations very literally after they are once adopted by authority.

The Deimel Light Company, Limited, are introducing two novelties in the form of a shadowless gas-light and a combination arrangement for lighting and cooking. The former consists of an ordinary burner in a white porcelain globe, which is attached to the bracket by the side, and not supported in the usual way; and consequently there is no shadow cast by the globe-holder. The other novelty is a movable pedestal lamp, fitted with a framework support for a shade or a kettle, so that it can be utilized in offices, bedrooms, chambers, or elsewhere, for both illuminating and culinary purposes. The lamp is connected with the gas supply by means of india-rubber tubing.

"PRO BONO PUBLICO."

One of the differences between the proceedings of the two national societies representing the British gas industry at their respective annual meetings of the present year has consisted in the circumstance that, while engineering topics mainly engaged the attention of the May meeting, that of June was the occasion for the publication of several novelties dealing with the utilization of gas by the consumer. This was particularly observable in the exhibits of the respective meetings. Not a single new burner or other appliance of the kind was in evidence at the professional gathering at the Royal United Service Institution; and the only communication relating to the application of gas (as distinct from its manufacture and other questions for the engineer and manager) brought before that meeting was Mr. George E. Stevenson's memoir upon the "Modern Gas-Engine." On the other hand, The Gas Institute meeting had before it several more than usually interesting and important novelties, appealing as much to the notice of the gas-consuming public as to the sympathetic study of technicians. The Penman oxy-coal-gas incandescent light for lantern and other uses, the holophane diffusing globes, and the Denayrouze improvement of the incandescent gas-burner, were actually shown in full operation in the hall of meeting in Edinburgh; and the much-needed improvement of gas heating-stoves was brought before the members in a suggestive manner that can hardly fail of the proper effect of stimulating makers of these articles to look a little farther than the immediate market. It is one of the functions of associations of gas managers to supplement the technical press in regard to the publication of new and improved methods of using as well as making and distributing gas; and it cannot be gainsaid that this purpose was fulfilled in respect of the matters and appliances already named as forming part of the business programme of the Edinburgh meeting.

It appears to us, however, that the task that should be recognized as falling to gas companies and their representatives, organized or otherwise, in regard to the education of the public in the art of making use of illuminating gas to the best advantage, goes beyond anything that can be efficiently done at these annual meetings. Never a year passes without bringing some new fruit of the ceaseless energy and remarkable ingenuity of the large and growing order of inventors who know that there is almost infinite opportunity and scope for their talents in this field of labour; while the stock of knowledge, in the possession of skilled technicians, of what already is and can be done, and available as the starting boundary from which new departures can be hopefully made, is enormously large. This information might and could easily be made much more fruitful than it is, if means were systematically employed for communicating it to the non-technical world. It is a commonplace of all science teaching that the cause of mechanical progress owes much to the initiative of amateurs, who often think of improvements and means of effecting them that would never occur to trained minds. On the other hand, a tremendous amount of effort, time, and money are continually being wasted by enthusiastic amateurs through their ignorance of considerations with which the technician is necessarily familiar, though in the ordinary way he keeps his knowledge to himself. The amateur of invention does not consult the professional as to what is working in his mind, for fear lest he might be forestalled in bringing it out; and so he goes on labouring at problems upon data which may, for all he knows, contain an absurdity fated to vitiate the issue. And, after all, after the technician and his unattached colleague the amateur have done their best, and effected an improvement competent to make the life of the ordinary citizen easier, to save his pocket, or to increase his chances of a prolonged existence, the citizen is left to make acquaintance with what has been done for him by means equally at the command of the charlatan and the fraudulent trader.

Much of this is inevitable, so far as the fortunes of new inventions are concerned. The proprietor of a meritorious invention may be a benefactor of the community in the second place; but in the first place his aim is to benefit himself. For attaining this end, he must rely upon himself; and it is no part of the duty of the State or of any public organization to help a member of the community who cannot or will not help himself. At the same time, it is possible and right for the community, or for a specially interested section of it, to encourage well-doing on the part of individuals. However, to recognize this as a principle is one thing; to carry it into sound practical effect is another. There is that which goes by the name of encouragement, which does not encourage; while the best and most fruitful encouragement may pass under another name, and only be recognized for what it is by those exceptional members of the community who are endowed with the gift of the seer. In the mechanical and industrial world, for instance, we know what is usually termed the encouragement of research and invention by the State or by a society. It commonly amounts to the offer of money prizes for success in achieving ends which would be attended with sufficient recompense for those who should be able to compass them in a legitimate and businesslike way. This is a sheer misuse of the term. There might be something to be said for it if prizes were awarded as compensation to those innovators who, without attaining to the end themselves, cleared the way for others, or to whom Fate had denied the ordinary financial reward of industrial success. For this reason, we do not countenance the idea of gas companies offering prizes for meritorious novelties relating to the conduct of the industry; nor are we contemplating for the moment the different question of the endowment of research. What we have in mind is something more easy of practical realization.

The idea is that in London and the largest centres of the gas industry, and for smaller places by a group of gas undertakings associated for the purpose, a new and distinct office might be created, which may be described as that of Inspector-General of Lighting and Gas Utilizing Appliances. The holder of such an office would, of course, be responsible to the engineer or general manager; but he need not necessarily belong to the ordinary gas-works staff. He should be a gentlemen of some scientific training; and while competent to specify and criticize ordinary gas-fitters' work, he should occupy himself mainly with the scientific and artistic side of gas lighting. It should be his care to look after opportunities for vindicating gas lighting in connection with new buildings, and accordingly to cultivate a relationship with architects and all public bodies, the managers of institutions, and the large shopkeepers and factory-owners. A good deal of tact would be required of an occupant of this office; but it should not be impossible for him to win confidence in himself as an adviser on points of lighting and cognate subjects that is not readily reposed in a purely gas-works official. It would be an important branch of his duty to take note of all suggested improvements of gas appliances; and to make use of the means of disseminating information among the people provided by lecture agencies and evening classes, for creating an interest in the matters committed to his charge. It would not be judicious to constitute him an apologist for the gas company or undertaking, or an opponent of any other system of lighting. All that is really required in this connection is that the truth about gas should be kept before the public. There would then be less of the opening that has hitherto existed in every community for the reception of false impressions in regard to matters of gas and other lighting. The Inspector would not write to the newspapers for the purpose of carrying on any controversy; but a prudent use of the "interview" and other means of keeping an active and enlightened local press acquainted with real facts of which its conductors are too often ignorant or careless need not be despised. In London alone there is ample employment for several suitably endowed professional gentlemen of the order we have indicated; and the principal cities throughout the United Kingdom could easily afford one apiece. Others, as already observed, might share the services of such an officer. Though the direct gain to a gas undertaking from the establishment of the new department might not often be traceable, yet indirectly, and in the long run, it is to be believed that it would pay very well indeed.

There is another way, in a sense connected with the foregoing suggestion, by which greater interest could be created in those subjects allied to lighting which are of such great practical moment for gas consumers. The study of practical optics might be encouraged in university colleges by the offer of prizes to students, the endowment of lectures, and similar measures that could be concerted between the teaching authorities and gas-works administrators. We do not speak here of the teaching of gas engineering or technics; but simply of the better cultivation of the science of optics as related to the practice of artificial lighting and illumination. Breadth of scope should characterize all efforts of this kind, which would be "throwing bread upon the waters." There could be no ordering of the shape in which the return should come. So far as we know, the gas industry has done little or nothing to assist the cause of scientific teaching. The teaching of the technics of the industry itself has only been spasmodically attempted. But even these tentative and occasional efforts have had great effect; and the standard of acquirement is now much higher among the very youngest recruits of the profession than was formerly held necessary. It should be the next task to educate the gas consumer; and this can perhaps be most hopefully attempted indirectly. We have on a previous occasion suggested a somewhat similar encouragement of art in regard to the design of gas-fittings by students.

It is the more essential that the instruction of the gas consumer should not be abandoned, by reason of the commercial turn that has been given to the now well-worn educational device of the last decade—the exhibition of gas appliances. Like all other industrial exhibitions, sectional or international, these occasional local displays of gas-utilizing apparatus have become simple devices for commercial advertisement, and have no more weight with the public than a trade circular. It is high time they were at least supplemented by something less identified with crude commercialism. The more immediately profitable they are, the less educational are gas apparatus exhibitions of the modern variety likely to be. They continue to serve a useful purpose in their way; but the purpose is something very different from that higher work which we suggest should be taken in hand in the manner indicated in this article—or, at least, in the same spirit. We do not insist upon details—the whole idea being but a mere suggestion, with only sufficient form given to it to render the conception intelligible. The great *desideratum* is to throw open, more patently than is

at present the case, the vast store of information which the best technicians and men of science unquestionably possess in regard to the practice of artificial lighting. It may, of course, be had now for the asking; but then those who need it most do not ask for it, but go on their way, wasting their money, and buying such knowledge as they ultimately acquire in the most costly and tedious of all schools—that of experience. Gas engineers may think, upon reading these lines, that since we are writing only concerning things that they know all about, it is unnecessary to evoke any other agency for providing and disseminating information. But how often is a gas manager consulted about the lighting of a public hall, or even of a public street, in the town he serves? These things are none of his business; and even granting him to know all about lighting, he has too much else to do to be always running after architects and public bodies with the object of seeing that they get money's worth for what they spend on gas. So, for one reason or another, it is quite exceptional to hear of skilled advice having been taken in regard to the lighting of (say) a railway station, a town hall, or even a line of thoroughfare.

It is unnecessary to cite additional reasons to show why the cultivation of the science of gas lighting is as worthy an object of the solicitude of a gas company at the present juncture as the pushing of the sale and hiring out of gas-stoves. The rent of a gas-stove shop in a fashionable quarter of a large city would pay the salary of a Chief Inspector of Lighting, and neither outlay would be felt by a gas company, while it might be difficult to say off-hand which would prove in the long run the more profitable investment. Both enterprises might be described as the outcome of an aggressive policy; and, in these days, industries that are not aggressive only too often turn out to be stagnant or degenerating. The gas industry in itself is all right, and likely to continue in prosperity; but on this very account it might well do a little more to help and secure the goodwill of the public that pays for all.

Gas Cylinders.—Professor Boys, Professor Harold B. Dixon, Dr. Dupré, the Rev. F. J. Smith, and Professor Unwin, who, as already mentioned in the JOURNAL, have been requested by the Home Department to inquire into, and report upon, the manufacture, filling, and use of gas cylinders, commenced their inquiry on Monday last week at the Home Office. Professor Unwin was elected Chairman. In the afternoon, these gentlemen visited the works of Brin's Oxygen Company, Limited. The inquiry was resumed on the following day, when Mr. Coxeter, Mr. J. Ralph, and Colonel Majendie laid their views before the Committee.

Sulphur in Oils.—Messrs. W. Fox and D. G. Riddick have been carrying out some tests of various oils, for the purpose of ascertaining the quantity of sulphur contained in them; and the results were given in a recent number of the *Chemical News*. The method adopted was to burn the oils by means of a floating wick, such as is used for night-lights, and condense, in a sulphur-testing apparatus, the vapours given off, in the same way as with coal gas. The experimenters found that Russian mineral oil (·908 sp. gr.) contained 20·5 grains of sulphur per gallon; Russian burning mineral oil, 10·3 grains; American do., 16·3 grains; American water-white mineral oil, 8·1 grains; American burning safety mineral oil, 14 grains; and Scotch mineral oil for gas making, 49·8 grains.

The Permeability of Earthen Dams.—As there has always been considerable discussion among engineers as to the permeability of earthen dams, interest attaches to some experiments recently made by the Boston (U.S.A.) Water Board, to obtain definite information on the subject. The matter is mentioned in the *Engineering Record*. The trials were conducted on the dam of the most complete reservoir ever constructed by the city authorities; and it was found that the leakage was at the rate of 60,000 gallons a day, or less than half the quantity passing through the dam of another reservoir. By means of a series of vertical pipes built into the dam at different points of its cross section, it has been found that the water-level in the embankment does not extend into the dam below the line of the core wall. The water percolates easily through the fine material placed against the up-stream face of the core, following the rise and fall of the impounded water in the reservoir, with a loss of head of about 1 foot only.

Gas-Engines for Pumping Sewage.—The Urban District Council of Rhyl have lately carried out a considerable extension of their sewerage system; and, in connection therewith, they have constructed an elevated reservoir, having a capacity of more than 380,000 gallons, for holding the sewage preparatory to its being discharged into the sea. The sewage is conveyed to the pumping-station, which is situated inside the gas-works; and within the buildings there are provided six engines for working the pumps. Two of the larger ones are each capable of lifting 300 cubic feet of sewage per minute (2,700,000 gallons per day) into the reservoir. The two intermediate engines can lift 45 cubic feet of sewage per minute. One of the larger engines would suffice to deal with the storm water, and one of the smaller ones with the ordinary sewage; but the second one provided in each case is for use in the event of a breakdown. There are two other gas-engines, which are used for working a screening apparatus—also in duplicate. All the engines were erected by Messrs. Crossley Bros., Limited.

NOTES.

The Cost of Producer Gas for Power Purposes.

Mr. W. H. Booth recently contributed to the *Electrical Review* a special article on the cost of producer gas, with reference to some statements of a Belgian manufacturer of steam-engines—Mr. Bollinckx—which were calculated to prejudice the rapidly strengthening case for the superior economy of gas-engines as compared with steam motors in general use. Mr. Bollinckx contended that producer gas cannot be made for less than 1c. per cubic metre, or about 2¾d. per 1000 cubic feet; and upon this basis he built up his argument. Mr. Booth has obtained from Mr. B. W. Thwaite a counter-statement that, in his every-day practice, the volume of producer-gas made per ton of slack may be taken as 123,600 cubic feet, consumed in a gas-engine after the rate of 90 cubic feet per brake horse power. At this rate, one ton of coal will yield 1373 brake horse power; and taking the slack as worth 5s. per ton, the cost of fuel gas would be brought down to 0·171 centime per cubic metre. With the foregoing figures, the consumption of fuel per brake horse power per hour is seen to be 1·63 lbs. This is the fuel consumption without any attempt at the recovery of anything from the inevitable wastes. Mr. Booth goes on to argue that this way of working is not allowed in these days in regard to the steam-engine, which is provided with a condenser, a feed heater, and other agents for economy. He accordingly asks whether, and how far, similar economies can be practised with gas-engines. In this connection, so far, no attempt has been made to employ any parallel to the economizer or feed heater. In a gas-engine, with producer plant, there are three great sources of waste—the cooling of the producer gas; the exhaust from the working cylinder; and the water-jacket. If, as suggested by Mr. Thwaite, the producer condensers could be cooled by the air on its way to the producer, and all the heat carried back into the latter, a maximum additional duty of 43·5 per cent. would be realized per pound of fuel. Then there is the possibility of recovering residuals from producer gas. Lastly, the water that cools the gas-engine cylinder might be compelled to return to the producer, in the shape of steam, all the heat it absorbs. These economies would mean an increased fuel duty of 50 per cent; and, in conjunction with the return from recovered residuals, would reduce the fuel consumption to an equivalent of ¾ lb. per horse-power-hour—a figure with which the steam-engine cannot possibly compete.

The Efficiency of Primary Batteries.

Dr. Henry Morton has found it desirable to explain in *Cassier's Magazine*, for the benefit of those who are likely to be deceived by the promises of inventors of primary galvanic batteries for use in lighting and other purposes, the ultimate possibilities of these appliances. He observes that some recent publications and other intimations indicate that, with the general revival of business, there are likely to be brought before the public various schemes in which electric energy, derived from galvanic batteries, will be relied upon as the source of power. Reference is only made to the class of batteries which long experience has proved to be the most efficient in supplying large currents, excluding those of the Leclanché type which yield only feeble currents. In all these batteries, the energy is derived from the combination of zinc with dilute sulphuric acid. Thus the amount of the energy obtainable can be expressed in thermal units. The oxidation of the zinc and the solution of the oxide in dilute sulphuric acid do the work. Nothing can be added to this—no arrangement of parts or the employment of one material or another in other parts of the cell, or for any other parts of the reaction, can add to the duty, while there must always be some sources of loss. The ultimate theoretical duty of zinc consumed at the rate of 1 lb. per hour is stated by Dr. Morton at 0·35 with the Smee cell, at 0·55 with the Daniell, at 1·06 with the Grove, and at 1·14 with the Poggendorff battery. Of course, says Dr. Morton, if we could use some other and more efficient reaction than that between zinc and sulphuric acid, some gain might be secured. But nothing of the sort has ever been accomplished; nor, from what is known of the combining or thermal equivalents of the available elements, is much to be expected in this line. At all events, it may be accepted as a certain fact, that in any known form of galvanic battery the round figure of 1 lb. of zinc per horse power per hour is an outside figure for efficiency; and when anyone asserts that more than this has been secured, there is certainly some mistake or fraud.

A New Selenium Photometer.

Professor Minchin has made a preliminary report to the Royal Society upon the result of his experiments, carried out at the Observatory of Daramona House, County Westmeath, upon the photo-electric measurement of starlight. The method employed in the experiments for determining the intensity of the light which reaches the earth from the stars and planets, consists in ascertaining the electrical energy generated by such light in certain photo-electrical cells; the square of this electromotive force being proportional to the energy of the incident light. In these cells, the surface on which the incident light is received is formed by depositing a thin layer of selenium on a surface of clean aluminium, and immersing the sensitive layer in a glass cell filled with œnanthol. The seat of the reaction is

the surface of contact of the liquid and the selenium. An examination of a seleno-aluminium cell with the various portions of the spectrum of lime-light shows that it is sensitive to all the rays from the end of the red, and below it, to beyond the violet—the maximum effect being produced in the yellow; but the magnitude of the effect does not vary very greatly until the violet is reached. In this respect, the seleno-aluminium cell differs from all other photo-electric cells, which are sensitive mainly in the blue. The energy incident on a photo-electric cell has been found to be proportional to the square of the electro-motive force generated. If one candle held at a certain distance from the cell gives a difference E of potential between the poles, two candles close together will be found to give a difference $E\sqrt{2}$. Or if a candle is tried at different distances from the cell, the difference of potential will be found to vary inversely as the distance. It would appear from this statement that Professor Minchin has been able to improve the selenium photometer.

Water-Meters versus Pumps.

Mr. Charles E. Bolling, the Superintendent of the Richmond (Va.) Water-Works, is greatly in favour of the general introduction of water-meters. The experiment is being tried in Richmond; and Mr. Bolling has recently reported that 95 per cent. of the consumers who use meters have saved largely in their water bills, and are pleased. It has often been found that the first bill after a meter has been fixed is a heavy one, which at once arrests attention, and the trouble is investigated. By this means leaks have been discovered which were secret, and had been going on for years. The works pumped last year a million gallons of water per day less than during the preceding year; and the pressure in the city was better. Mr. Bolling maintains that measurement is the only equitable method of charging for water. To avoid complaints, he would place a meter on every service, and charge according to the present rates up to a certain consumption—any extra to be charged for by measurement. Unless more meters are fixed, more water will have to be pumped. The Richmond City Council are at present opposed to the meter system. But Mr. Bolling declares that the meters economize pumping; and he sees no reason why water should not be paid for like gas—by measurement.

TECHNICAL RECORD.

WESTERN (U.S.A.) GAS ASSOCIATION.

(*Continued from Vol.* LXV., *p.* 1378.)

Mr. Allen S. Miller, of New York, read a paper on "Metal Gasholder Tanks." He remarked that the site for the gasholder was usually selected without reference to the suitability or otherwise of the ground. Even if satisfactory at first sight, and after testing by bore-holes, it was no uncommon thing for unexpected springs, quicksands, or boulders to be met with in the course of construction; largely increasing the cost and the difficulty of making the tank sound. He then proceeded to show that the risk of such inconvenience and loss could be avoided in the first place, not merely without extra cost, but with some economy. If a steel tank was put down, instead of a masonry one, the outlay for excavation would be saved, and that for the foundations greatly reduced. The cost of excavation ranged from 1s. to 3s. 4d. per yard, according to circumstances—such as the size of tank, facility for disposing of the spoil, extent of pumping required, &c. Brickwork would cost £2 to £3 12s. per yard, according to locality; a mason laying 1000 to 1500 bricks per day in mortar made of one part by measure of Portland cement to three of sand. No figure could be given to indicate the cost of stone. Quoting from actual facts, in one case the cost of a brickwork tank, 102 feet diameter by 21 feet deep, was about £3350. A similar tank in another locality cost £3780. The outlay on a tank of equal size in steel was about £2400, exclusive of foundations. A brick tank 82 feet diameter by 20 ft. 8 in. deep, cost £2200; but a steel tank of similar size, less than £1600. Taking nine tanks of steel, ranging from 57 feet to 125 feet diameter, and from 19 feet to 31 feet deep, he found the cost varied from 3·3d. to 3·7d. per cubic foot capacity. Brickwork tanks would cost 30 to 60 per cent. more. Certainly the expenditure for maintenance was greater in the case of steel; and more steam would be required in frosty weather. The extra cost of this was shown by calculations to amount to about £50 per annum. Against this it might be said that masonry tanks often required repairing. As to durability, he saw no reason why steel tanks should not last indefinitely; proper care being taken to grout the bottom. He summed up the advantages of steel, as compared with masonry tanks, as affording a possibility for making a close estimate, giving absolute tightness, saving of time in erecting, and saving of cost; the extra cost for maintenance being more than covered by the interest saved on capital. He had just witnessed the completion of a steel tank 190 feet diameter by 50 feet deep; and it proved perfectly tight. The plates in the bottom course were the largest ever rolled in America; being $1\frac{3}{4}$ inches thick, 4 ft. 4 in. wide, and 24 ft. 9 in. long.

Mr. Clark thought that, with careful workmanship, it was as easy to make a tight masonry tank as a tight steel one. The latter was quite as difficult to repair as the former. When a masonry tank was once properly finished, it required no further attention at all; and he had yet to be convinced that it was not possible to make a sound job. Many of those that were now leaky could easily be made tight and firm; and if a good coat of asphalte was put all over the interior in the first place, so much would not be heard about leaky tanks. So far from requiring less, he thought steel tanks required more foundation; as there was less likelihood of getting a good bed at the surface than 20 or 30 feet below. Mr. Forstall had observed that a 50-feet steel tank required more steam to keep the ice out than a 125-feet masonry tank. Mr. Humphreys considered the facts warranted the claim that it was easier to make a tight tank of steel than of masonry. The remarks made by Mr. Clark about foundations did not always hold good; they had all heard of heavy weights being put upon floating foundations. By simply levelling the surface, it was practicable to provide for very heavy weights by a proper arrangement of concrete foundation; whereas by excavating, all sorts of soil were met with, which might or might not cause great trouble. If there was any doubt as to the site, an iron or steel structure should be chosen.

Mr. Miller, in the course of his reply, said he claimed that a steel tank required less foundation than a masonry one, because the weight of the iron or steel used was very much less than that of the brick or stone. There was a great difference between the weight of iron plates and thick masonry walls. As to foundations, of course, in some cases, there might be swampy ground on the top; but in many others, there was a good surface and a bad substratum. As to repairs, everything was in favour of the steel; as it was easier to caulk or set up a strained joint, than to repair a cracked wall. Side leaks in a metal tank could be stopped from the outside without pumping out; but in any case care was required in laying the bottom.

Mr. G. H. Harper, of Altoona (Pa.), read a paper on the "Advantage of the Metric System;" producing the well-known arguments in favour of a universal system of weights and measures, as compared with the various standards of different countries. The unit of linear measure should be an aliquot part of the circumference of the earth; and when applied to length, breadth, and thickness, it should give the standard for linear, square, and cube measure, whilst the unit of cube measure in distilled water should furnish the standards of weight and capacity. The commerce of over 400 millions of the world's population was to-day carried on under the metric system; but Britain and the United States held, not only to complicated Government systems, but also to many "customs of trade" measures or weights.

Mr. Clark thought there was no doubt as to the advantages offered by the metric system, which was gradually being adopted for scientific purposes all over the world, and would no doubt eventually come into universal use. Mr. Thompson said that the American Metrological Society had been agitating in favour of this movement for 23 years; and he quoted extracts from pamphlets issued by the Society. He concluded by proposing—"That this Association authorize the use of the metrical system in its reports and transactions, and that it join the American Metrological Society as an Association." Mr. Forstall seconded the proposition; and it was carried. Mr. Greenough questioned whether the metric system had made much progress during the last 15 or 20 years; and he thought it would be a long time before it came into general use. Mr. Miller said there was another side to the question. The inch was largely used in Germany and France, for gauges, taps, bolts, and such things, because the metrical system was found unsuitable for shop practice. While useful for the scientific portion of their proceedings, he thought it would not do for the commercial and practical part.

Dr. Slocum, of Pittsburgh (Pa.), read a paper on "Acetylene," illustrated with experiments. In the course of some historical notes on the discovery of calcium carbide, he mentioned that corresponding nitrite compounds had also been found, which evolved ammonia by contact with water. Speaking with some practical experience, he put the cost of the calcium carbide at 3d. per lb.; so that at present it was outside practical considerations. He enlarged on the suitability of acetylene for use as a standard of light; and promised further information on this head at a future date.

A paper entitled "Experience with Foul Gas," was read by Mr. J. T. Lynn, of Detroit (Mich.). The author described the difficulties caused by a fracture in one of the division-plates of the purifier centre-valve, which rendered it impossible to avoid passing foul gas. The water in the station meter and gasholder tank became quite foul and black; and the complaints from the consumers were so numerous, that he was obliged to fit in a new centre-valve at once, although this happened in the middle of the winter. He had to run lime water into the gasholder tank, in order to purify the water; and an unexpected effect of this course was that the inlet-pipe—which had been bye-passed for some years, on account of its leaky condition—was rendered sound, and put into use again. Though in this case, the bye-pass between the inlet and outlet had proved useful, he did not at all approve of the use of such an arrangement as a permanent thing. He proceeded to argue in favour of systematic testing at the purifiers, and of apparatus of ample size, according to the kind of coal used. This consideration was frequently overlooked altogether;

but as a matter of fact, there was great difference in the proportion of sulphuretted hydrogen evolved from various coals, and even from successive consignments of the same kind of coal.

The next paper was entitled "Recuperative Furnaces as applied to Bench Firing; their Operation and Results." The author was Mr. J. A. Faux, of Pittsburgh, who commenced by describing the difference between a full-depth and a half-depth furnace. He said that the steam used at the base of the furnace should be first superheated by being caused to circulate through pipes surrounding the ash-pit; thus securing a considerable saving of heat without extra expense. The superheated steam was also useful in its effect upon the mineral matter in the fuel, which would be converted entirely into ash, and not burnt to clinker; and another advantage was the facility it afforded for controlling the temperature in the generator. The combustion chamber should be sufficiently large to prevent any flame from passing into the flues. The chemical action should be completed at this stage, as the flues, or possibly the chimney, were not the proper place for combustion to occur. In ordinary furnaces, more than half the fuel was wasted; and especially was this the case when bituminous coal was used as fuel. With regenerator furnaces, any kinds of fuel could be used, including those of a very inferior class. When using bituminous coal, care must be taken to secure the complete combustion of the volatile hydrocarbons. At present, 100 lbs. of slack coal had been carbonized with 11 lbs. of the inferior coke afforded by it; and the author argued that it would be possible in theory to reduce this to 8¼ lbs. Bearing this in mind, it was rather startling to find that many ordinary furnaces required 25 lbs. or more of fuel per 100 lbs. of coal carbonized. In conclusion, some figures were quoted which went to show that very high yields are only secured by an excessive use of fuel.

Mr. G. Osius, of Detroit, was the author of a paper on "Ammoniacal Liquor." He made the astonishing statement that, out of nearly 1000 gas-works in America, only about 150 utilize the ammonia, and that the quantity run to waste by the remainder would be equal to over 7,000,000 lbs. weight of 20 per cent. liquor. With this waste going on, large quantities of ammonia were imported. He proceeded to consider how it would pay to utilize the ammonia; and whether there would be risk of over-production if all of it was put on the market. Even for works as small as 7 million cubic feet per annum, it was worth while to put down a plant for concentrating ammoniacal liquor; and an incidental advantage would certainly be that the purifying capacity of the liquor would be fully utilized—economizing the cost of purification, and improving the quality of the gas. No inconsiderable quantity of light tar at present went to waste with the liquor; and all this would be saved. As to the question of over-production, he enumerated the various uses to which ammonia was applied. During the last two years, no less than 26,000,000 lbs. had been imported, and the demand was increasing; so there was plenty of room for disposal of all the ammonia they could save, and also for that from coke-ovens and blast-furnaces as well. The present production was about 30,000,000 lbs. of sulphate of ammonia, the whole of which was absorbed for agriculture alone.

Mr. James Somerville opened the discussion by arguing that, whether utilized or not, it was cheaper to take out the ammonia in the washers and scrubbers than in the purifiers; and also that the purifying capabilities of the liquor should be fully utilized. At present, he realized 1s. 8d. per ton of coal carbonized for his ammonia. All tar should be extracted before the gas reached the purifiers. Mr. Forbes said he lately commenced the utilization of the ammonia; and he could support all that had been said in the paper. Mr. Young had taken up the concentration of liquor; and though there was some trouble at first, he was now doing well with it, and was satisfied with the pecuniary results. He found that the product must be tested by distillation or acid, and not by the hydrometer; as if a considerable proportion of sulphur was present, the results by specific gravity would be much too high. Mr. Clark asked for some recent experiences in the use of limed coal for increasing the yield of ammonia. Mr. Osius, in the course of a reply to several questions, directed attention to the importance of properly storing the strong liquor. If this was not attended to, there would be great loss.

A contribution on "The Best Method of Introducing Gas-Engines" was received from Mr. E. G. Cowdery, of Milwaukee, describing the course he had lately taken. First he collected accurate details from users of gas-engines, as to work done and cost of gas. This was printed in pamphlet form, and distributed to every user of power in the district. Meanwhile, the local agency for all engines not otherwise represented was secured. The pamphlet led to inquiries and orders; and the profits on the sales nearly paid all the expenses. Later on, there was a local industrial exhibition; and he exhibited a 12-horse power gas-engine driving electrical machinery, and gave away 10,000 copies of a "Gas-Engine Primer." He followed up with liberal advertising and personal canvassing; aiming chiefly at large users requiring 50-horse power and upwards. He commenced operations in November, 1893; and the result of the first year's work was the placing of 20 engines, representing an aggregate of 148-horse power, in addition to 47 previously in use. A new edition of the pamphlet was issued last January; and there had been a steady demand for engines ever since. This showed that it paid to go to some trouble and expense in making known the truth about gas-engines. The selling price of these appliances was, however, much too high; and gas associations should see if anything could be done in the way of getting them reduced. A 25 per cent. cut would still leave good profits, and yet it would double the sales.

(To be continued.)

THE USE OF GAS AND OIL ENGINES FOR WATER-WORKS IN GERMANY.

Some time ago, Herr Max Munzel read a paper, at a meeting of gas and water engineers at Lansberg, on the subject of the employment of gas and oil engines in connection with the supply of water. He has since dealt with the subject in an address to the Cologne section of the German Society of Engineers; and an abstract translation of his remarks appeared in a recent number of the *Engineering Record*. From this the following particulars are taken.

Ten years ago, only the steam-engine was considered available for pumping when a suitable water power could not be found; but to-day engineers are no longer so restricted, and are able to use gas-engines for such work. The amount of the necessary power is hardly a hindrance to the employment of the latter; since motors of 200-horse power, and higher, can be bought. The use of more than this power in German water-works practice is exceptional; and in the 85 pumping plants mentioned in the statistics compiled in 1894 by the Society of Gas and Water Engineers, only five had pumps of more than this power—viz., Zurich, Hamburg, Dortmund, Augsburg, and Barmen. In those cities and towns where it is impracticable to operate the motors with the ordinary lighting gas, they can be run by gasoline and petroleum. The leading advantage of the gas-engine is that it needs no boiler and chimney, and thus saves space—an important matter in some places. As regards safety and durability, it is equal to the steam-engine; while so far as superintendence is concerned, the gas-engine has the advantage. One man can look after a number of motors and pumps if arranged in a single room; and his duties are not difficult—consisting principally of starting and oiling. A steam plant of moderate size requires an engineer and fireman, and possibly a coal handler. Another advantage of the gas-engine is its availability for immediate service. After lighting a single gas-jet, the largest pumps may be put in operation in four or five minutes, which is of great importance in case of a fire or extraordinary demands for water. This also warrants the construction of smaller water-towers, since the engine supplying them can be run intermittently, as often as desired, without any loss of gas during the time it is still. Steam-pumps can only be kept ready for use by maintaining a fire under the boilers all the time, which necessitates a constant expense for fuel and attendance. These considerations also point to the value of a gas-engine as a reserve in a steam-plant that runs normally at or near its maximum capacity. Pumping by gas-engines is also advantageous to a gas plant, as the harder pumping occurs during the daytime, when the demand for gas is otherwise slight; while less water is required during the evening, when more gas is needed for illumination.

The authorities of Duren selected gas-engines in 1884 to operate the new water-works—being the first to introduce the system. The innovation made a wide impression; and in the same year, the city of Quedlinburg replaced its steam pumping plant with one operated by gas-engines. In 1886, Rottwill and Coblenz made the same change; Furth and Peine followed in 1887; and Carlsruhe and Munster in 1888—the last employing producer gas because illuminating gas was not supplied easily. These early plants have now been running for six to nine years, with satisfactory results. The works in Quedlinburg, Furth, Coblenz, and Carlsruhe are after much the same plan as the one at Duren. According to the report on the Quedlinburg Gas and Water Works for 1885-6, the cost of fuel for raising a million gallons of water was about £3 15s. with coal, and only about £2 with gas.

The water-works of Carlsruhe offer an example of the advantageous union of steam and gas pumping plants. The former is the older; and the gas-engines are installed within an annex to the original building in such a manner that all the machinery is in a single room, and under the supervision of one engineer. The increase of the plant by two gas-pumps has required no addition to the number of employees, and but a slight increase in the extent of land occupied. The water-level of the suction and the limited available space led to the selection of deep vertical pumps. The ground plan of the annex is only 54 feet by 33 feet. It contains two sets of pumps, each of a capacity of 55,000 gallons per hour, raised to a height of 154 feet. The two 50-horse power engines make 140 revolutions a minute; and the pump-cranks, 38 revolutions. The pump-pistons are 13·4 inches in diameter, and have a stroke of 32 inches. From the air chamber common to both pumps, a 20-inch pipe leads to a junction with the force-main of the steam plant, and with the 24-inch pipe to the water-tower. An 18-inch pipe branches out from the first-mentioned line between the air chamber and the junction; so that water can be pumped through it directly to the distributing-pipes, if so desired.

In all these early plants, the power was transmitted by means of gearing; and though this has served its purpose, an attempt has been made in more recent plants to avoid its use, especially because of the troublesome noise. The gearing was principally necessary on account of the great difference in rotary speed of the motors and pumps. In recent years, there has been an essential improvement in the construction of pumps; and there is no longer any difficulty in securing power pumps which will run at 60 to 80 revolutions a minute without jar or noise. This uniformity of operation is secured in several ways; that which the officers of the Deutz Gas-Engine Works have found best being a combination of three single-acting plunger pumps.

The water-works at Leer and Treuen may be taken as representative of small plants using belt connections. In both there are two-cylinder pumps with single-acting plungers driven by cranks, making an angle of 180° with each other; the effect of this construction being to cause a delivery similar to that of a single double-acting pump. This arrangement has the advantage of combining unusually good access to the valves with great firmness. The crosshead is cast in a single piece with the plunger, and moves in guides formed by a prolongation of the walls of the cylinder. A fast and a loose pulley are carried on the shaft between the main bearings; the former serving also as a fly-wheel. Specially good results are obtained with belt connections compared with gearing, when the pumps are lower than the motors, as in this case, because it is possible to use horizontal pumps, and avoid entirely the weight of a vertical plunger. Each motor has a capacity of 10-horse power, which can be increased to 11-horse power later if the project of supplying water to Emden, 15½ miles distant, is carried out. The plungers are 5·2 inches in diameter, and have a stroke of 12 inches. At 72 revolutions a minute, each pair of pumps delivers about 8450 gallons an hour to a height of 197 feet. A combined air and suction chamber serves for the entire plant. From the suction chamber a 7-inch pipe runs to the well; and from the air chamber a pipe leads to the water-tower—a tank supported on four columns of wrought-iron pipe, in which the rising pipes are placed. The engine-room is only 36 feet by 25 feet; and the entire pumping-station measures but 67 feet by 36 feet.

At the Treuen Water-Works, the motors and pumps are on a level. In this station there are also two independent sets of machinery, with engines of 12-horse power each, and double pumps with an hourly capacity of 6330 gallons each, raised to a height of 287 feet. The plungers have a diameter of 4·6 inches, and a stroke of 12 inches. The suction and force mains are 6 inches in diameter. In other respects the plant at Leer and Treuen are similar. The pumps have annular spring valves of bronze, with cast-iron seats and two rings. They operate easily and without shock, even at high speeds, on account of the careful arrangement of the suction and air chambers. The gas-engines have incandescent tube igniters, and make 180 revolutions a minute. They are easily started by hand, by throwing the belts on the loose pulleys of the pumps; and directly they run properly, the belts are shifted to the fixed pulley.

The triplex pumps have shown in practice that their theoretical advantages are mechanically obtained. The uniformity with which they absorb energy—the variation in a revolution being about 20 per cent.—actually produces smooth running of the belt without the aid of special fly-wheels. The first works using these were built at Göttingen in 1892; and the result was so successful that they have been installed ever since by the Deutz Gas-Engine Works for large plants. The Göttingen pumping-station was constructed to help out the older gravity supply. The pumps take water from a well about 260 feet from the station, and deliver it to a tank about 1 86 miles distant, at an elevation of 153 feet. A 10-horse power engine and a triplex pump, having a capacity of 7900 gallons an hour, were first set up; but the building was designed to accommodate a second set of machinery when it became necessary, which was in the following year. This latter set consists of a 12-horse power motor and a pump, with an hourly capacity of 14,900 gallons. The pump-room is about 36 feet long and 26 feet wide. There is a single combined suction and air chamber for both pumps, and a single 8-inch force-main. The smaller pump has a 4-inch suction-pipe; and the larger pump, one of 6 inches. Both have a stroke of 12 inches, and run at 75 revolutions a minute; the engines making 180 revolutions. The plungers of the pumps are 4 inches and 5·6 inches in diameter for the smaller and larger sets respectively.

The pumping-station at Meissen cost £6000 in round figures, which includes the outlay for the building, motors, and pumps. The works at Constance are much like those at Meissen in arrangement. The engine is of the single-cylinder type, of 23-horse power, and makes 160 revolutions a minute. The pumps make 75 revolutions a minute, and deliver 38,000 gallons of water an hour to a height of 82 feet. The plungers are 8·8 inches in diameter, and have a stroke of 12 inches.

The plant at Wolfenbuttel, which was started in November, 1894, has a jack shaft, by which it is possible to drive either pump by either engine. The machinery is located at the base of a round stone water-tower, having a clear inside diameter of 39·4 feet at the bottom. The wrought-iron tank is built according to the methods advocated by Professor Intze. Each of the triplex pumps delivers hourly 26,400 gallons of water to a height of 148 feet. The plungers have a diameter of 7·4 inches, and a stroke of 12 inches; and they run at the rate of 75 revolutions a minute. The engines have a capacity of 25-horse power each at 170 revolutions, while the intermediate shaft runs at 125 revolutions. Fast and loose pulleys are carried on both the pumps and intermediate shafts. One man can turn the fly-wheel of an engine when the belts are thrown on the loose pulleys; and as soon as it comes to speed, the belts can be shifted to throw either pump into service. If both pumps must be operated, the second engine can be started from the first by means of the intermediate shaft.

All the preceding works have motors running with illuminating gas; but those using producer gas, gasoline, or petroleum, are arranged in much the same way, and drive the same kind of pumps. In deciding between the last three types of motor, the most important factors are the size of the proposed plant and the availability of the crude fuel. As a rule, the most economical plants using not more than 12-horse power are those with gasoline or petroleum motors; while for works requiring more than this power, the advantage lies with producer gas. The fuel employed in the generation of this gas is either anthracite or coke; and the works at Munster and Basel may be taken as examples of plants employing it. At Munster it was adopted on account of the distance of the pumping-station from the gas-works; while at Basel it was chosen because of the unusually low price of coke.

The Munster works were built in 1888, and contained originally a 30-horse power motor, which was duplicated in 1890. Each set of pumps delivers 30,000 gallons of water an hour to a height of 177 feet. The gas-generating plant consists of two producers and two boilers (half the plant acting as a reserve), with the necessary purifiers and gasholders. The plant is located in a well-ventilated room adjoining the engine-room; so that all the apparatus is looked after easily by one man. The well is in the engine-room, and has such a depth that a deep-well pump is necessary. This is of the duplex type, with differential pistons. The motor makes 140 revolutions a minute, and the pump axle 30 revolutions. The entire plant, including the producers and a coal-shed, is 65 feet long and 49 feet wide.

The system at Basel is still in course of construction, and supplements the older steam plant. A two-room addition was built at the station, to contain the pumping machinery and the generating apparatus; and a gasholder has been erected near. The new plant is to contain two independent sets of pumps, each capable of delivering 95,000 gallons of water an hour to a height of 308 feet; but at present only one set will be installed. The gas-generating room contains three producers and two small steam-boilers—one producer and one boiler being in reserve. The engine has two cylinders, and a capacity of 210 brake horse power when supplied with illuminating gas, and 170-horse power with producer gas. The pump is of the same sort as those at Meissen and Göttingen—a single-acting triplex pump, with the cranks arranged at angles of 120°. Spring annular valves, with five rings and a lift of 0·4 inch, are employed. Below the suction-valves there is a long suction chamber; while there are large pressure-caps over each pressure-valve, as well as a large wrought-iron air chamber. The plungers have a diameter of 10·4 inches, and a stroke of 28 inches. The pump-shaft makes 60 revolutions, and the engine 140 revolutions a minute; and the belting consists of ten cotton ropes, 2 inches in diameter.

This is the largest water-works system yet installed by the Deutz Gas-Engine Works; and it is the first in which the friction coupling has been omitted. This coupling was formerly necessary in order that the engine might be started; but at Basel a little barring engine of 8-horse power has been installed, which is worked by a water-moter, and is powerful enough to bring the engine to a speed of 20 revolutions a minute, provided the bye-pass of the pumps is opened. When the engine has been run at this speed for a few revolutions, the ignitions become regular, and the speed increases until the proper rate is attained—the barring engine being automatically stopped meanwhile. Finally—the bye-pass valve is closed, and the pumping begins. A connection is made between the city gas-mains and the gasholder; so that, in case the plant has to be started on short notice, it can be run with illuminating gas during the interval (one to two hours) needed to heat the producers and boiler.

Gasoline engines are as easy to manage as those using illuminating gas. When the apparatus is filled, a few turns of the fly-wheel will start the engine. The type made at Deutz has electric igniting apparatus; and the gasoline reaches the cylinder in a gaseous form, and not as a liquid. The oil-engines cannot be started so quickly as those using gasoline. The back cylinder head has to be warmed some time, so that the oil entering the cylinder will be vaporized by the hot surfaces, and a good explosive mixture produced. For supplying water to a single building or a group of buildings, the motor and pump are erected together. The plungers are connected to the shaft of the motor, and make as many as 250 double strokes a minute. The valves are provided with springs; and the suction and air chambers are designed so that this high speed can be maintained without noise or shock. Such combinations are in use in small plants where the head rises as high as 230 feet.

For larger installations, the general arrangement does not differ from that of the gas-engine pumping-stations. The plant

at Rothenburg, where the population is about 7000, has horizontal belt-driven pumps placed somewhat lower than the main floor of the building. The engines are of the single-cylinder type, each having a capacity of 10 brake horse power at 180 revolutions per minute. Each engine has a separate gasoline apparatus, placed in an annex to the main building. The pumps are of the kind used at Treuen, and each delivers about 5800 gallons an hour to a height of 295 feet. The plungers have a diameter of 4·4 inches, and a stroke of 12 inches. The plant at Hohenstein uses oil, as the pumping-station is about 2½ miles from the city; and this fuel can be most easily transported to it. The pumping-station was built to supplement a supply from springs. The average quantity of water furnished is 6600 gallons an hour, delivered against a head of 170 feet. The bulk to be delivered may be varied, without altering the speed of the engine, by changing the stroke of the pump-plungers; the crank-pins being adjustable along the cranks for this purpose. The engine has a capacity of 6 to 8 horse power at 200 revolutions per minute; and it drives a two-cylinder pump, having plungers 5 inches in diameter and of 12 inches maximum stroke. The works at Nierstein (population 3500) and Obercassel (population 2000) are still smaller; and owing to the depth of the suction water-level below the surface, and the long plunger-rods, it was impossible to avoid the use of spur gearing. The Nierstein works have two single-acting pumps, with three suction and discharge valves of hard rubber held down by springs. The plant is operated by a 4-horse power motor, and lifts 4000 gallons an hour to a height of 144 feet. At Obercassel, a triplex pump is driven by an 8-horse power engine, which lifts 6600 gallons an hour against a head of 230 feet.

The Bavarian Bureau for Water Supply designed the plant for Markt Presseck in Oberfranken, a place of 1100 population. The water has to be raised to an elevation of 400 feet; but the quantity is small—only 2300 gallons an hour. The plant consists of a 6-horse power gasoline engine, belted to a differential pump with plungers having a diameter of 4 and 2·8 inches, and a stroke of 12 inches. The fixed wheel on the pump-shaft is built heavy, to act as a fly-wheel, and thus make the load on the engine more steady than would otherwise be the case.

In comparing the duties of steam-pump plants, the number of foot-pounds of work done per unit of fuel burnt is often taken as the basis of comparison; and in gas-engine pumping plants, the number of foot-pounds per cubic foot of gas may be used similarly. The variation between the thermal value of illuminating gas in different cities is probably less than that between the thermal value of different coals; so the comparison on this basis is probably more accurate than that of steam-pumps. The following table gives the approximate duty in foot-pounds of gas-engine plants:—

Name of City.	Number of Engines.	Horse Power.	Number of Cylinders.	Duty, Foot-Pounds.
Duren	Two	40	Two	46,300
Quedlinburg	Two	15	One	48,100
Coblenz	Three	40	Two	52,800
Furth	Two	40	Two	52,800
Carlsruhe	Two	50	Two	51,400
Kettwig	One	15	One	46,200
Eimbeck	Two	10	One	47,100
Bingen	Two	12	One	51,000
Göttingen	One	10	One	51,400
Göttingen	One	12	One	51,400
Meissen	Two	50	Two	66,800
Constance	One	16	One	69,700

The plants in the above table are arranged in the order in which they were installed; and it will be noticed that there is a fairly constant gain in the duty. Those first installed had too large engines; while the improvement in the more recent plants is due principally to the use of better methods of connecting the pumps and engines, although various alterations in the design of the motors also contributed to this result. At the Munster works, it was found that about 187 lbs. of coke and 450 lbs. of anthracite were used in ten hours; so that the duty of the plant per pound of fuel is about 747,000 foot-pounds. The consumption of coke in the steam-boiler of the Munster plant is stated to be nearly three times greater than it should be. The gasoline motors at Rothenburg have a duty of about 1,600,000 foot-pounds per pound of gasoline. The plant at Hohenstein had an average duty in 162 days of 1,720,000 foot-pounds per pound of petroleum.

An Electric Lighting Act for India.—A Bill has been prepared by the Bengal Government to facilitate and regulate the supply of electricity for lighting and other purposes in Calcutta; no power in this respect being at present possessed by them. If passed, the Bill will enable the Government to grant licences for the supply of electric lighting within any part of the city. The Bill closely follows the Electric Lighting Act of 1882; the Local Government being substituted throughout for the Board of Trade. The definition of Calcutta is taken from the Calcutta Municipal Act of 1884; but power is given for extending its provisions to the Howrah Municipality. The necessary powers for breaking up streets, &c., have been adopted for the most part from the Gas-Works Clauses Act, 1871.

REGISTER OF PATENTS.

Gas Motor Engines.—Griffin, S., of Bath. No. 13,298; July 10, 1894.

This invention relates to gas-engines in which two motor cylinders are mounted (in combination), side by side, with their axes parallel, and working with the ordinary double cycle, so arranged as to impart an impulse to the crank-shaft alternately from each cylinder at every revolution at full power.

Hitherto such engines have been arranged with two independent pistons and connecting-rods; each piston and connecting-rod actuating a separate crank attached to the same shaft. But to dispense with the extra complication and weight involved in this arrangement, the patentee proposes to mount two single-acting double-cycle cylinders side by side in a water-jacket, with their axes parallel—the cylinders, together with their pistons, being somewhat longer than usual, in order to afford ample guiding surface and rigidity in working. The two pistons are rigidly connected together at or near their outer ends, by means of a light strong crosshead, at about the centre of which (advantageously equidistant between the two pistons) is jointed a single connecting-rod, attached in the ordinary way to a suitable crank and shaft. The shaft may be arranged to work either in a line with, or at right angles to, the bisection of the axis of the cylinders.

One modification consists in mounting two such combinations, side by side, with the bisections of the cylinders at right angles to the crank-shaft, in such a manner that the connecting-rod of each pair of cylinders will actuate a separate crank. The two cranks are advantageously combined with the same shaft; being set at an angle of 180° with each other—opposite. The valve-gearing is so arranged that an impulse takes place in one cylinder of each combination or pair alternately in succession, at full power; each crank thus receiving an impulse once in every revolution. By this means, increased power is obtained, with steadiness of running and freedom from cyclical variation; the reciprocating parts being at the same time balanced.

According to another arrangement, two such combinations as previously described are mounted opposite each other, with the axes of the cylinders in line; the bisection of the combined cylinders being either in line with, or at right angles to, the crank-shaft, as convenient. The connecting-rod of each pair of cylinders actuates the same crank; an impulse being imparted to it twice in each revolution, at diametrically opposite points. Ignition takes place in one cylinder of each combination or pair alternately in succession at full power, as has been already described.

Generating Combustible Gas.—Thwaite, B. H., of Finsbury Pavement, E.C. No. 13,385; July 11, 1894.

The essential characteristics and qualifications of this invention are described by the patentee as follows: It is found by experience that, in order to permanently fix the hydrocarbon gases from semi-bituminous coal, these gases should be compelled to flow under pressure through a column of incandescent coke, or other carbonaceous fuel. To effect this essential condition continuously, and without involving any reversal action, he provides two vessels connected together in their upper portion by a flue so arranged that the heated gases and flame from one vessel pass into the adjoining one. Each vessel has a specific function to fulfil. In the first vessel, the inception of fuel combustion and its continuance is established in such a way that part of the heating effect of combustion is, by the passage of the flame or highly-heated gases through the fuel in the second vessel, transferred to the column of fuel in the second vessel; and the newly-fed fuel in both vessels has its hydrocarbon gases driven off, and they (along with the carbon monoxide gases from the first vessel) descend through the incandescent fuel in the second vessel. The fuel incandescence is obtained by the partial combustion of the gas and the complete combustion of part of the solid fuel in the first vessel. In descending through the incandescent fuel, the following effects (thermic and chemical) take place: First the volatile hydrocarbons are gasified and converted into a condition more or less permanent. The carbon dioxide produced by the partial combustion of the gas, as well as the complete combustion of part of the solid fuel in the first vessel, is converted (in contact with the incandescent carbon in the second vessel) into carbon monoxide. Any water vapour or steam flowing into the second vessel is decomposed in passing through the column of incandescent fuel in the second generator; the oxygen forming, with the incandescent carbon, carbon monoxide, and the hydrogen being set free.

In one arrangement, the depth of fuel in the first vessel is maintained of such dimensions that, when a powerful air blast is established under the fire-grate, a portion of the air passes through the fuel, and consumes part of the gas generated by the partial combustion of the fuel in the first vessel. The effect of this combustion in the first vessel, raises the temperature of the part of the first vessel above the level of the fuel, as well as the fuel in the second vessel (through which the treated gases have to descensionally pass), to a high temperature—the fuel in the second vessel being raised to the equivalent temperature of visible incandescence. In adopting this arrangement, the first vessel is made much shallower than the second vessel. Indeed, it may be merely a fire-grate, in which the fuel is entirely consumed—relying for the production of a combustible gas on the passage of the products of combustion through the incandescent fuel contained in the second vessel.

Instead, however, of employing a shallow layer of fuel in the first vessel, and in order to obtain the necessary temperature of incandescence in the second vessel, the first vessel may have such a depth of fuel as to enable a regular character of gas to be generated in the first vessel. Part of this gas is consumed by the introduction, under pressure, of a certain proportion of atmospheric air, introduced either directly over, or merely under the surface of the fuel in the first vessel. The flame resulting from this combustion passes immediately into the second vessel, through the fuel of which it descends, raising the temperature of the vessel, and the fuel contained in it, to high incandescence. The chemical and thermic effects of the action of gasification are as described for the first arrangement of the invention.

The chemical principles underlying the non-reversal cycle of power

gas production are described by the patentee as follows, neglecting the diluent nitrogen:—

First, at the grate—

$$C + 2\,O + H_2O = CO_2 + H_2O.$$

Second, above the grate—

$$CO_2 + H_2O + 2\,C = 3\,CO + 2\,H.$$

The oxidation of the hydrocarbons adds other constituents, as follows: For simplicity, let the ratio of C to H_4 represent the constitutional character of the hydrocarbons, then $CH_4 + 4\,O = CO_2 + 2\,H_2O$. In the passage of these gases through the fuel, raised to incandescence by the effect of the oxidation of the hydrocarbons, the following recarbonizing action occurs:—

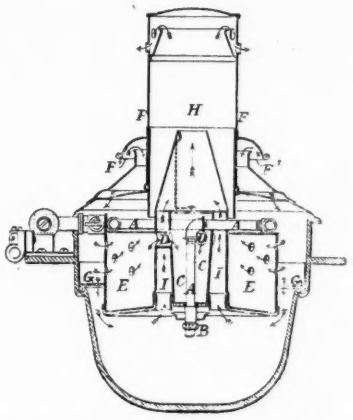
$$CO_2 + 2\,H_2O + 3\,C = 4\,CO + 4\,H.$$

So that the final result is—

$$(3\,CO + 2\,H) + (4\,CO + 4\,H) = 7\,CO + 6\,H.$$

Regenerative Gas-Lamp.—Allison, C. A.; communicated from C. Assi and L. Genès, of Paris. No. 7446; April 11, 1895.

The essential feature of this invention consists in the employment of a conical chamber or tube, tapering from the top downwards, and through which the central gas-pipe passes. The chamber is open at the bottom; and below it the burner is arranged. It is closed at the top; but near the top it is provided with radial passages, communicating with a chamber to which air from the outside of the lamp is admitted. The products of combustion from the flame pass up the chimney, through a space left between the conical tube and the outer passage last referred to.



The illustration shows a method of applying the invention to existing railway-carriage lamp-casings, by inserting the lamp from above into the ordinary casing carrying the glass.

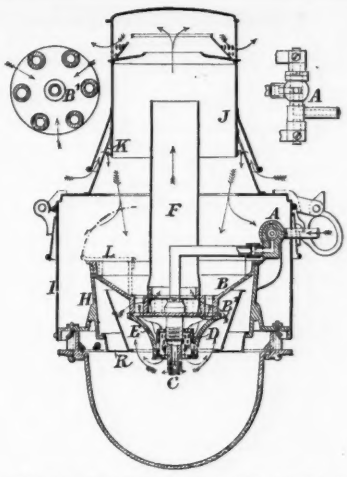
A is the gas-pipe, which passes down the centre of the lamp and terminates in the burner B. Surrounding the vertical part of the pipe is a conical chamber C, tapering from the top downwards—the bottom being open—and below which the burner is fixed. The top of the chamber C is closed, as shown; while near the top one or more (preferably three) radial passages D are provided, communicating with an air chamber E of annular form, the outer wall of which is provided with perforations. Air enters the outer casing F of the lamp at F^1, and passes into the chamber E through the perforations; thence, through the radial openings D, into the chamber C; and down to the top of the flame of the burner. A portion of the air also passes down outside the chamber E, through perforations in a plate G, which supports the chamber; and so to the underside of the flame. The products of combustion pass up the chimney H, through the space I between the conical chamber C and the air chamber E. The top of the lamp is hinged, so that it can be turned back to ignite the lamp; while for cleaning the glass, the heating chamber and reflector can be removed from above, by turning them back on the hinge-joint of the gas-pipe.

Regenerative Gas-Lamps.—Lamp Manufacturing Company, Limited, of Leonard Street, City Road, and Welch, W. H. I., of Bow. No. 8317; April 26, 1895.

This invention relates to overhead regenerative gas-lamps of the kind described in patent No. 123 of 1893; and it has for its object "the construction of lamps of this kind in such a manner as to give great facility of access for lighting and cleaning."

The gas is supplied through a joint A (of ordinary construction) supported on fixed pins, which enter holes in its ends. The gas-pipe is attached to, and passes through, the centre of a dished-piece B, the upper part of which is connected to its lower part or disc B^1 by several tubular bosses. On the gas-pipe, which extends down to the burner C, is screwed a perforated hollow cone D, which presses an inverted hollow conoid E up against the disc B^1. All these parts, and the gas-pipe from A, as well as the chimney F, which rests on B, can be turned upwards on the joint A as a hinge, giving free access to the parts below. The glass globe may be hinged in the usual way; but as access is had from above, it may be fixed (as shown) by a ring to the stationary part H, into the upper mouth of which fits the upper rim B, which forms a lid or cover to H.

The reflector R has attached to it a conical shell projecting up from it. It also has a lip resting on an inwardly projecting lip at the lower part of H. The outer casing of the lamp consists of a lower part I, which is stationary, and has hinged to it (and fastened by a catch) all the upper part J, which is provided in the usual way with shielded apertures for ingress of air and egress of the products of combustion. On releasing the catch, the upper casing J can be turned back on the hinge and the gas-pipe and parts attached to it can be turned back on the joint A. The reflector R and its conical shell are then lifted out; and free access is given to the interior of the glass for cleaning.



The reflector being replaced, the burner being lighted, and the parts B D E being turned down into the positions shown, the lamp operates as follows: Part of the air entering at the shielded apertures K passes down to perforations, by which it enters the globe to supply the underside of the flame, and part passes through the perforated cone D, to supply the upper side of the flame. The products of combustion ascend, and pass inwards through the intervals separating the bosses to the chimney F. As the parts are highly heated by the products of combustion, the air reaches the flame at a high temperature, causing "complete combustion and great brilliancy of light."

APPLICATIONS FOR LETTERS PATENT.

11,513.—Maynes, J., and Watchurst, C. L., "Separation of gases." June 13.

11,550.—Gurd, W. J., "Automatic lighting devices for gas-stoves." June 13.

11,565.—Wadsworth, G., and Liddle, S. W., "Coin-freed gas-meters." June 14.

11,571.—Snelgrove, W., and Goyne, R. F., "Water-pipes." June 14.

11,577.—Shadbolt, R. G., and Broadhead, J. W., of the firm of Messrs. R. Dempster & Sons, Limited, "Enriching coal gas." June 14.

11,625.—Moul, H. E., "Atmospheric gas-burners." June 14.

11,668.—Botley, C. F., "Incandescent gas-burners, &c." June 15.

11,703.—Haddan, R., "Giving warning of the presence of escaped gas in rooms or the like." A communication from J. Serra and Co. June 15.

11,709.—Hewitt, J. T., "Steam, air, and gas rotary engines, and exhaust and compression pumps." June 17.

11,722.—Phipps, T. L., "Preventing water-pipes bursting from frost." June 17.

11,726.—Perlich, A., "Burner for spirit-gas incandescent light." June 17.

11,758.—Torre, C. D., and Mancini, F., "Instantaneous automatic electric lighter for all kinds of gas-burners." June 17.

11,783.—Rossbach-Rousset, F., "Acetylene gas-lamp." June 17.

11,814.—Shand, W., "Gas cooking-stoves." June 18.

11,815.—Terrace, J. B., "Improved Bunsen flame." June 18.

11,820.—Gardner, H., "Combining air and gas for incandescent lighting purposes." A communication from La Société Française de l'Héliogène. June 18.

11,848.—Lake, H. H., "Utilization of combustible gas." A communication from E. N. Dickerson. June 18.

11,866.—Hibbert, T., "Water-service stopcocks, or attachments therefor." June 18.

11,887.—Gardner, H., "An incandescent irradiator for gas without the preliminary admixture of air." A communication from La Société Française de l'Héliogène. June 18.

11,888.—Gibbons, W. P. and G. B. A., "Charging gas-retorts." June 18.

11,925.—Melhuish, A. G., and Beaumont, C., "High-speed gas or hydrocarbon engine." June 19.

11,981.—Hacker, H., "Gasholder frames." June 20.

11,987.—Tee, H., "Gas and like pendants." June 20.

12,019-20.—Hersey, S., and Kirkham, Hulett, and Chandler, Ltd., "Washing or scrubbing gas." June 20.

12,035.—Phipps, T. J., "Cutting off gas or electric current at any desired time." June 20.

12,061.—Hooker, C. E., "Protector for self-lighting gas-burners and self-lighting gas-caps of all descriptions—for example, Duke's self-lighting gas-burner." June 21.

12,092.—Denayrouze, L., "Gas heating and cooking apparatus." June 21.

12,131.—Pennink, J. M. K., "High and low pressure gas-generator." June 22.

12,134.—Dunolly, A., "Automatically charging gas-retorts with coal." June 22.

Reductions in Price.—The price of gas at Sudbury (Suffolk) has been reduced 3d., and at Lavenham 10d. per 1000 cubic feet, as from the 30th ult.

Extension of the Scarborough Gas-Works.—At a special meeting of the Scarborough Gas Company last Wednesday, a resolution was passed authorizing the creation of new ordinary 5 per cent. stock for the purpose of raising the additional capital of £60,000 required for extending the undertaking.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

The Southwark Bridge Explosion.—The South Metropolitan Company's Profit-Sharing System.

SIR,—Having resolved to appeal, nothing can be said by me in relation to the Southwark Bridge explosion, except to make the statement that it was given in evidence that the Company did not know the City Contractor had opened and improperly filled in the ground until after the accident.

A statement is also necessary on another subject referred to in this week's JOURNAL. Your correspondent who objects to our system of profit-sharing—or perhaps I should say to our use of the words—makes the strange mistake in assuming, as others who might be expected to know better have done before, that the whole amount appropriated under that heading should be added to "carbonizing wages." You have shown his error by stating that all the Company's employees participate—that is, all, from the chief officers through all grades down to the humblest labourer in regular employment who accepts our agreement (as nearly all do), have their part in the profit-sharing, in the shape of a certain percentage, dependent upon the price of gas, on their salaries and wages. The only men ineligible are those employed casually, chiefly in the retort-houses, and the winter stokers who are engaged for less than three months. So far, therefore, from the whole amount of £12,435 10s. 9d. entered as "profit-sharing" being paid to the carbonizing men, they actually receive less than one-third of that sum. This is paid to them annually in addition to their wages. The wages are at the rates current throughout London, and it amounts to a little over 1d.—say 1¼d.—per ton of coal. Your correspondent may add this to the 2s. 7d., and make out of it what he pleases.

GEORGE LIVESEY.

South Metropolitan Gas Company, June 29, 1895.

Carburetted Water Gas.

SIR,—I have noticed with interest the correspondence which has been going on in the JOURNAL relative to the above. Having had twelve months' practical experience in the manufacture of water gas, where both systems were in use, I have no remarks to make on the advantage of the one over the other. But by the knowledge I have gained in America, I come to the conclusion that its sole success depends more on the manipulation of the machine than the design. I should have understood the "M.W.P." machine to be a double superheater type, quite as much as the Humphreys and Glasgow, but a combined. Where the "double" comes in, I fail to see. If the oil were sprayed on the fuel-bed in the generator, then I should say the term "double superheater" might be correct in Humphreys and Glasgow's setting.

ALFRED G. BROWNING.

Manchester, June 27, 1895.

The Inflammability of Terebene.

SIR,—A small fire having occurred at these works a short time ago, the cause of which could not be traced, and some painters having been at work on the premises at the time, I was led to make the following experiments, the results of which may prove interesting to some of your readers. I moistened a piece of rag, 3 feet square, with a mixture of terebene, linseed oil, and turpentine—materials which are in constant use by painters. The rag was then rolled up into a ball, with a thermometer placed in the centre; and, on being left, the following were the results: During the first hour, the temperature rose from 20° C. to 87° C., and the rag began to fume; in the next hour, the temperature increased to 310° C.—the rag fuming strongly; while half an hour later the rag was burning, the temperature being 360° C.

Whether or not these results indicate the cause of the fire, you may possibly consider them of sufficient importance to be made known in the interest of those who use terebene, and who may not be aware of its inflammable nature in conjunction with certain other materials.

T. WILTON, Manager,
The Gaslight and Coke Company's Tar and Ammonia Products Works.

Beckton, E., June 26, 1895.

Sloping Retorts at Brentford.

SIR,—The credit of bringing the inclined retort system to its present efficiency should certainly be shared by the engineers of provincial gas-works, who were the first to adopt it on a large scale. Mr. T. Banbury Ball, of Rochdale, erected and worked the first installation, consisting of five beds of seven through retorts in 1890. These gentlemen advocated and adopted this method of carbonizing; and, at their own expense, they introduced many improvements which I see are now embodied, and claimed as original, in the last installation at the Brentford Gas-Works. The introduction of: (*a*) 24½ and 26 inch ⏢ section retorts, (*b*) taper retorts, which are certainly necessary for rapid discharging, together with (*c*) the addition of the lug on the mouthpiece for holding the coal stop, and several other details that go to make the system a success, were all working in the provinces before either the Bow Common or the new installation at Brentford was started.

Having myself been connected with the erection of the majority of the inclined retort plants now working in England, I am able to substantiate my statements by reference to dates and the names of the gas-works in which these improvements were working prior to their introduction at Brentford.

I notice Mr. Van Vestraut, in your issue of the 4th inst., says that royalty is being paid on the patent of Morris and Van Vestraut, No. 16,489 of 1889, for charging three or more tiers with one telescopic shoot. This shoot was discarded after working on the experimental bed at the Southall Gas-Works; and Mr. Ball introduced the three single charging shoots (which were not telescopic). This is, at present, the recognized method.

As nobody seems to have cleared up the last paragraph in Mr. Husband's paper with reference to the drawings, I may say that the Automatic Coal Gas Retort Company, Limited, received from Mr. Morris drawings of the measuring chambers, tanks, &c., which were then working profitably at the Brentford Gas-Works; and, therefore, Mr. Morris is entitled to the credit of designing the "powder flask" method of charging inclined retorts. It was from these particulars, with an improvement of my own embodied, that patent No. 20,709 of 1892 was prepared and applied for, in the names of Van Vestraut and Graham.

In conclusion, I would say, in justice to the engineers who have adopted this system, that not only at Brentford, but in every case, these gentlemen have given every opportunity of inspecting the plants they have erected, at all times supplying information *ad lib.*, and continue to do so.

MAURICE GRAHAM.

Lime Street Square, E.C., June 27, 1895.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following progress was made with Private Bills last week:—

Bill presented and read the first time: Liverpool Electric Supply (Transfer) Bill.

Bills read a second time and committed: Brighouse Corporation Bill; Local Government Provisional Order (Gas) Bill.

Bills reported, with amendments: Brighouse Corporation Bill; Cranbrook District Water Bill; Local Government Provisional Order (Gas) Bill.

Bills read the third time and passed: Brighouse Corporation Bill; Gas Orders Confirmation Bill; Gas and Water Orders Confirmation Bill.

HOUSE OF COMMONS.

The following progress was made with Private Bills last week:—

Bills read the first time: Barnsley Corporation Water Bill; Gas Orders Confirmation Bill; Gas and Water Orders Confirmation Bill; Rotherham Corporation Bill.

HOUSE OF LORDS COMMITTEE.

(*Before the Earl of* JERSEY, *Chairman; Earl* GREY, *the Earl of* DARTMOUTH, *Lord* CALTHORPE, *and Lord* CRAWSHAW.)

DEWSBURY AND HECKMONDWIKE WATER BILL.

This Bill, which, among other things, is to empower the Dewsbury and Heckmondwike Water Board to construct additional works, and to authorize the Heckmondwike District Council to sell their share in the undertaking to the Dewsbury Corporation, and to provide, in the event of such sale, for the dissolution of the Board, came before the above Committee on the 18th ult.

Mr. PEMBER, Q.C., Mr. BALFOUR BROWNE, Q.C., and Mr. FREEMAN appeared for the promoters. The following were the petitioners against the Bill, who were represented by the Counsel named: The Sheffield Corporation, by Mr. LITTLER, Q.C., Mr. CRIPPS, Q.C., Mr. PAGE, Q.C., and Mr. GERALD FITZGERALD; the Rotherham Corporation, by Mr. BIDDER, Q.C., and Mr. BAGGALLAY; the Doncaster Corporation, by Mr. WORSLEY TAYLOR, Q.C., and Mr. RAM; the Soothill Urban District Council, by Mr. J. D. FITZGERALD; the Duke of Norfolk, by Mr. ERSKINE POLLOCK, Q.C.; Messrs. S. Fox and Co., by Mr. WORSLEY TAYLOR, Q.C., and Mr. READER HARRIS, Q.C.; the steam-users of the Don, by Mr. CRIPPS, Q.C., and Mr. J. D. FITZGERALD. Petitions against the Bill had been presented by the West Riding Council and Rivers Board. The objections of these bodies were, however, almost identical with those to the Barnsley water scheme, to which reference was made in the JOURNAL for June 4 (p. 1201); and having regard to the decision in that case, they reserved their opposition. The three Corporations above named were prepared to contend that all the water the Joint Board required, if they really needed any, could be obtained by constructing a reservoir at the head of the River Holme.

Mr. PEMBER, in opening the case, said the question the Committee had to decide was nearly similar to that which had been decided in the Barnsley inquiry. The existing reservoirs of the Board were known as the Dunford Bridge, Windleton, Snailsdon, Harden, Upper Windleton, Lower Windleton, Whitley, and Dewsbury Gate. The proposed new reservoir was to be in the watershed of the Little Don, and was to be called the Little Don reservoir. All the reservoirs on the Don were completed, with the exception of the Snailsdon and Harden, both of which were in progress, and would be finished by September next year. When these were ready, the total supply of the Board would be 3,440,000 gallons of water a day. The promoters proposed to take 2700 acres, and impound the water from this area for the purposes of the additional supply, out of a total of 11,500 acres. The total capacity of the proposed reservoir would be 330,000,000 gallons; and they had arranged with the millowners to give a supply of 1,500,000 gallons a day as compensation water. Like Barnsley, the promoters had a good many outside districts depending upon them for water. The existing works were owned by the Dewsbury Corporation and the Heckmondwike District Council, in the proportion of three-fourths by Dewsbury and one-fourth by Heckmondwike. Besides Dewsbury and Heckmondwike, the promoters were under a 20 years' agreement, of which 12 years had still to run, to supply Ossett. There was also a 15 years' agreement with Soothill, of which 11 years had to run. Flockton had a 30 years' agreement, of which 29 years were unexpired. The total population of the district was 68,500; and the consumption of water in 1894 was 2,177,000 gallons, or thereabouts—an average of 30 or 31 gallons per head per diem. In Dewsbury, the consumption amounted to 40 gallons per head daily; the reason being that the trades

of the town were such as required a great quantity of fresh water—as much as 14 gallons per head per day being consumed for trade purposes alone. Dewsbury was also peculiarly situated topographically. It was a difficult town to drain; and a large body of water was required for flushing purposes. Besides, it was a water-closet town in the fullest sense of the term. With regard to its present needs, in 1887 the town was in great straits for water. To increase the supply, it was necessary to pump from a disused coal pit, and to purchase the water from the millowners and from neighbouring authorities. In 1893, the Corporation had again to purchase water. After such experiences, he ventured to assert that Dewsbury was only acting wisely and prudently in coming to Parliament with a scheme for an additional supply. The Corporation calculated that, in a very short time—three to five years hence—they would be absolutely at the end of their present resources. This meant that Dewsbury would be in serious straits for water at the end of (say) seven years from now. Their present surplus was some 430,000 gallons a day; and this would only last about three or four years. The principal opponents of the Bill were the Corporations of Sheffield, Rotherham, and Doncaster; the millowners and steam-users on the River Don; Messrs. Fox; and the Duke of Norfolk. The promoters proposed to meet the larger oppositions thus: To the Sheffield, Rotherham, and Doncaster Corporations, they would say: "This small slice of watershed does not really concern you." Sheffield, Rotherham, and Doncaster had large unused resources. The small watersheds in the Bill were at a great distance from them; and geographically they lay close to the authorized Dewsbury works. Parliament had already allowed Dewsbury to go into the watershed of the Don; and they now only proposed to take away water from a tributary of the river. They said, as Barnsley had said, that the proper and statesmanlike course was for the little towns to take the waters from the little watersheds close at hand, and leave the large towns, who could better afford it, to go a long distance for their additional water supply.

Mr. *E. Mawdsley*, the Town Clerk of Dewsbury, and Clerk to the Dewsbury and Heckmondwike Water Board, was examined by Mr. FREEMAN in support of the statements made by Mr. Pember. He said that from June to October, 1887, their supply was greatly restricted; and they had to pay £2700 for additional water. In 1893, they did not purchase so much; but still they had to buy of the millowners.

In cross-examination by Mr. LITTLER, on behalf of the Sheffield Corporation, witness said the agreements alluded to for supplying the outside districts were all comparatively recent ones—the earliest being in 1883. The water undertaking was not carried on at a profit. The Heckmondwike District Council had been opposing the Bill; but an agreement between the two authorities had been arrived at.

Questioned by Mr. CRIPPS, on behalf of the steam-users on the Don, witness stated that Dewsbury felt bound to supply the outside districts, even if they bought water for them. They spent £2700 on the purchase of water in 1893; having bought 12 million gallons in that year. They sold 220 million gallons to the outside districts, and to Barnsley 46 million gallons, or some 26 millions above their normal supply. They gave 4½d. per 1000 gallons for the water they bought, and sold it to Barnsley at 7½d. per 1000 gallons; but this fact did not lessen their need for water in the future.

Cross-examined by Mr. READER HARRIS for Messrs. S. Fox and Co., witness said he was aware of the great value of their works, and knew they were dependent for their prosperity upon their water supply. He presumed they had an adequate supply at present. He was aware that the Little Don was the only available source upon which Messrs. Fox could depend. The promoters had not approached Messrs. Fox, as they had done in the case of the other millowners. He did not think the promoters were acting arbitrarily in taking the proposed water to supply outlying districts at the cost of Messrs. Fox's works. As a matter of fact, he did not think Messrs. Fox would be sufferers by the scheme at all, owing to the amount of compensation water to be sent down. The scheme was simply an extension of one which Parliament had already sanctioned for the supply of the outlying districts. He was prepared, on behalf of the promoters, to say that, if Messrs. Fox now approached them, they would be prepared to make reasonable terms with them, as they had done with the other millowners.

Mr. *M. Oldroyd*, M.P. for Dewsbury, and holding public and business positions in the borough, in answer to Mr. FREEMAN, said the water of the Don was eminently adapted for the purposes of dyeing. The water of the Calder was largely used for dyeing and scouring; but it was utterly unfit for the more delicate treatment of fabrics. The trade of the district had become one that required a constant and ample supply of fresh water if it was to maintain its prosperity.

On the following day, further evidence was given on behalf of the promoters. In the course thereof, it was stated that, owing to want of water, work was being sent out of the district. The Borough Surveyor of Dewsbury (Mr. H. Marks), who is the Engineer to the Joint Board, informed the Committee that water was supplied to various districts by meter; and he admitted that this was done at a loss. Nevertheless, they contracted in 1887 to supply Ossett at 6d. per 1000 gallons; the water having been previously supplied by Batley at 6½d. He acknowledged that, if the outside supply were cut off, there would be plenty of water for Dewsbury. Mr. Marks's evidence was confirmed by Mr. G. H. Hill, M.Inst.C.E., who stated that the great fault of public bodies was to put off their water schemes too long. It was, he said, the height of folly to delay the carrying out of new water-works. At the close of this evidence, the Committee adjourned.

On the resumption of the proceedings the next day, further evidence was given in support of the promoters' case. Mr. Paterson, who said he was well acquainted with the districts now being supplied by the Joint Board, assured the Committee that it was impossible for Wakefield to supply them when their contracts with Dewsbury expired, as Wakefield had quite enough responsibility on its shoulders at the present time. With regard to Bradford, the Corporation had no statutory power, nor had they the capacity, to supply, even if they desired to do so. But, at any rate, they would have to take their pipes through Dewsbury to do it. Asked if it was a proper thing for an authority to sell water to outside districts at a loss, witness thought it was, under certain circumstances. A millowner on the Calder testified to the great irregularities in the supply of water for the mills on the river, and said it was essential for their prosperity that the quantity should be increased. The Parliamentary Agent of the promoters (Mr. Pritchard) explained certain financial features of the Bill; and the promoters' case closed. The Chairman then expressed a wish to confer with the members of the Committee before hearing the petitioners against the Bill. The room was accordingly cleared. On the parties being re-admitted, the Chairman said the Committee would not call upon the opponents of the new works proposed in the Bill to proceed with their opposition, as they were not prepared to pass that portion of the Bill. He explained that this did not refer to the No. 9 works. Mr. Freeman (for the promoters) remarked that this left those works, and the borrowing powers of £40,000 for completing the authorized works. By No. 9 works it was proposed to reconstruct a portion of the old works. The proposals for borrowing powers and the clauses of the Bill were then finally adjusted; and the Bill was ordered to be reported.

HOUSE OF COMMONS COMMITTEE ON LONDON WATER BILLS.

(*Before the Right Hon.* D. PLUNKET, *Chairman; Sir* J. KITSON, *Sir* H. STAFFORD NORTHCOTE, *Mr.* BALDWIN, *Mr.* BURNIE, *Mr.* MUNTZ, *Mr.* P. STANHOPE, *Mr.* AINSWORTH, *and Mr.* BRIGGS PRIESTLEY.)

Seventeenth Day—Friday, June 21.

Mr. *James Bigwood*, M.P. for the Brentford Division of Middlesex, was examined by Lord ROBERT CECIL in support of the case of the Middlesex County Council, of which he is an Alderman and Chairman of the Parliamentary Committee. He stated that the Council in their opposition represented not only themselves, but the other local authorities in the county. The Water Companies having a right of supply in the county were the New River, the East London, the Grand Junction, and the West Middlesex. Other Companies had power to supply parts of Middlesex; but their power was not exercised to any extent. He maintained that Middlesex had a primary claim upon the water found within the county, and complained that as the river supplies became less in quantity, in seasons of drought, the Companies pumped more from the chalk, which lowered the Middlesex wells. The New River Company had wells at Highfield, Campsbourne, and Betstile, within the County of Middlesex. Middlesex wanted to stand entirely aside from the general question of the London Water Supply; and that was the position which they had taken up from the beginning. It was inexpedient that London should acquire the powers of any of the Companies in Middlesex, as the interests of the two counties would be antagonistic; and he feared that the transfer of the undertakings to the London County Council would lead to an increase of the rates. He looked upon the whole question as being a very huge piece of business, about which it was very doubtful indeed to prophesy that it would be a financial success; and in the event of its not being so, the rates must increase. If they went to distant sources of supply, they might throw an unfair proportion of the expenditure upon Middlesex, by means of a differential rate. Middlesex had enough water for its own purposes, and more to spare; and he was afraid that London might make a greater demand on the spare water, in which case Middlesex would have to pay for its property twice over. He did not see that any benefit would arise to Middlesex from the transfer.

The CHAIRMAN: Are the inhabitants, so far as you know, at present tolerably well satisfied as to the quality of the water?

Witness thought they were. At present, of course, the Water Companies were not in popular esteem, in consequence of the late frost; but probably the public had not thought that in the event of meeting such a disaster as that in future, a good deal of money would have to be laid out in the lowering of the mains, and in the junction of these mains (which were the parts most likely to be frozen in the first instance) with the private consumers' taps. With this exception, Middlesex was satisfied with its supply; for the water was excellent in quality and abundant in quantity.

In cross-examination by Mr. WORSLEY TAYLOR, witness stated that he thought the water supply to London inadequate; and he would be willing to assist in the solution of the difficulty, so long as they did not interfere with Middlesex.

The CHAIRMAN said that some of the representatives of other outside authorities seemed to think that, if there were to be a purchase, they would like to purchase the water themselves, use what they wanted, and give the surplus to London.

Witness said he would have no objection to that course. Certain schemes had been foreshadowed—such, for example, as the transfer to Middlesex of the Grand Junction, the West Middlesex, and certain portions of the New River Company's works.

Mr. *Thomas Fenwick*, M.Inst.C.E., said that he had been largely engaged in all questions affecting the supply of water to various towns, in the construction of water-works, and the selection of drainage grounds for reservoirs for the last thirty years. The Grand Junction Company's works—except certain mains and pipes, and the high-level pumping-station at Campden Hill—were all within the jurisdiction of the Middlesex County Council. The pumping-engines at Hampton and Kew had an aggregate of 3514-horse power, drawing a supply of nearly 19 million gallons a day from the Thames and gravel beds. They had 245 miles of mains, supplying a population of about 136,500 outside the Metropolitan area; and 190 miles of mains within the County of London, supplying a population of 249,000. A 30-inch and a 12-inch pipe were in the Bath main-road, and a 30-inch and a 24-inch main in the Uxbridge main-road, which conveyed the water from the outside district into Hammersmith and Kensington. The West Middlesex Company derived all their supply from Hampton, where they had engines of 560-horse power. They pumped 19 million gallons of water a day through Hampton, Teddington, and Twickenham (by two 36-inch mains), into their reservoirs at Barnes. There it was filtered, and thence conveyed to the engine-wells at Hammersmith, from which it was pumped by engines of 1605-horse power into the district of supply. They had 127 miles of mains, supplying a population of about 95,000 outside the Metropolitan area; and 340 miles of mains within the County of London, supplying a population of about 486,000. The Middlesex County Council were, therefore, very much interested in the

control of these works; and he thought it would be unfair to allow the London County Council to have sole control of them. If the London Council were the controlling authority, they would be empowered to sink wells, and abstract from the county of Middlesex water which should be preserved for the material increase of population which there would be in the outer districts. If there were a deficiency in supply, or a drought, it would be possible for the London Council to favour the population inside London; or if they abandoned the Thames as a source of supply, either wholly or in part, they then could enforce upon Middlesex a partnership in the contemplated scheme. Such a scheme might be proper and advantageous for London; but Middlesex did not need it. It would be an easy matter to let the whole of the supply now brought in from the Thames by the West Middlesex Company be sent into the county of London, to be consumed there; and the Grand Junction Company, by withdrawing their supply from inner London altogether, could keep it for the supply of Middlesex. That would leave them free from intervention or interference from the London County Council, and would not saddle them with the burden of a great commercial undertaking. He cited a number of towns in which the charge for the outside districts was greater than within the borough.

In cross-examination by Mr. Balfour Browne, witness said that he thought the system of charging a higher price outside was quite fair, as they were not responsible for any loss on the water undertaking; and it was a principle authorized by Parliament.

Mr. *W. G. Austin*, Deputy Clerk of the Peace for Middlesex, gave evidence as to the difficulties in the way of the Middlesex County Council promoting Bills in Parliament, as illustrated by the Bill which they proposed to introduce in relation to the River Brent in 1893, the expenses for which the Local Government Board refused to sanction. That proposal was to deal with the question of pollution, and had no reference to the water supply.

Mr. *G. E. Eachus*, M.Inst.C.E., gave evidence as to the sources supplying the north-east corner of Middlesex. He said that, if the four wells belonging to the New River Company there were left under the control of Middlesex, they would properly supply that portion of the county with water. They would suffer very much if this supply were placed under the domination of the London County Council. He was proposing to quote some figures as to the cost, when—

Mr. Balfour Browne objected to going into the question of the cost of buying up these works, as they were only dealing at present with the Lambeth and Southwark and Vauxhall Bills.

Lord Robert Cecil urged that it was a pertinent matter on the preamble.

The Chairman said witness might go into it in a general way.

Witness said that what he wanted to show was that the water undertakings were much more profitable within the area of London than outside; and consequently if the London County Council bought up the Water Companies, and then sold back the portion in their district, they would practically have to "pay through the nose" for the portion left to them, because it would be the most unprofitable part of the undertaking. Assuming that the purchase-money of the New River Company was £9,000,000, and they required in the Middlesex district approximately one-sixth of the supply of the New River Company, if they had to pay one-sixth of the £9,000,000, it would be £1,500,000, which would be roughly equal to two years' full rateable value of the outside districts supplied; and without adding any expense for bringing water from Wales, or even the ordinary annual expenses, it would load that portion of Middlesex with at least a 2s. rate. At present they did not have to pay half that; and it struck him that Parliament took into account that the outer districts gave the water, and that the inner districts of London would help to pay and ease the burden to the outer districts in return for their giving the necessary water.

Mr. *Edwin J. Lovegrove*, engineer, spoke as to the capability of the Campsbourne well of the New River Company to supply the Hornsey district; and he objected to it being handed over to the London County Council.

Mr. *D. J. Ebbitts*, the Engineer and Surveyor to the Acton District Council, stated that Acton, on account of the large number of laundries, required more than the 35 gallons per head which (under clause 24 of the Bill) was to be allotted to the local authorities outside.

Mr. Worsley Taylor said that was a matter which could be dealt with in the clauses of the other Bills.

This concluded the evidence for the Middlesex County Council.

Sir *John Evans* was then examined by Lord Robert Cecil on behalf of the Hertfordshire County Council. He objected to London having any authority in Hertfordshire. There was no doubt that already the water supply of Hertfordshire was very seriously depleted by the demands of the two London Companies which drew a large portion of their water from the county. If the supply of the Companies was transferred to the London County Council, he feared that they would extend their demands upon the Hertfordshire water. They would have great difficulty in contending with so powerful a body as the London Council; and it would be far more difficult to deal with them than with the Companies. He was not altogether in agreement with the report of the Royal Commission. He had already pointed out in *The Times* that, whereas they proposed to draw only a limited quantity of water from the Thames, they stated that there was power along the valley of the Lea to extend the supply of water from that district by about 22½ million gallons a day by means of wells; and that in other ways 40 million gallons might be drawn from the River Lea and its valley, either by means of the river or by wells. In September, 1894, his prophecies were fulfilled, because the East London Company notified to their consumers that their supplies would be cut off during the night, so that they might economize their water to the extent of ten million gallons a day. Practically therefore the amount given by Nature was 10 million gallons a day less than that on which the Company had been formerly relying, and was certainly 50 million gallons a day less than the Water Commission said might be safely drawn from the valley.

The Chairman said he did not quite follow the object of this evidence, because these considerations would be delegated to the Arbitrators.

Witness explained that, as the London County Council were so strongly against drawing water from the river, he feared that they would take advantage of their position as the Water Authority along the Lea Valley to extend the wells; and that pumping from wells would affect more materially their springs and wells in Hertfordshire than drawing from the river would do. The Company were merely entitled to withdraw the excess of water that was flowing to waste; and, under the new conditions, in all probability, the actual sources of water would be intercepted.

Lord Robert Cecil further explained that, there being no legal rights of property in underground water, the New River Company's pumping was already drying them up to a certain extent; and they feared that the London County Council, with their hostility to the river water, would naturally pump more and more from the chalk, and completely dry them up.

Witness was proceeding to give further evidence in support of his view as opposed to the Royal Commission, when

Mr. Bidder objected.

The Chairman asked that only general evidence should be given, as the Committee did not wish to make themselves a tribunal to review the findings of the Royal Commission.

Witness proceeded to point out that, in consequence of the pumping, certain water-cress beds had dried up; and he mentioned that at Rickmansworth a private individual had bought about a quarter of an acre of land just above the junction of two streams, in which he had fixed a pumping-station, and advertised the water for sale.

Mr. *John Hopkinson*, F.G.S., F.R.M.S., was called to give evidence as to the rainfall in Hertfordshire, and as to the action of the East London Water Company in September, 1894, in consequence of the diminution of the water of the Lea, when

Mr. Bidder again objected that they could not go into any question between Hertfordshire and the East London Company.

Lord Robert Cecil urged that it was relevant, as the diminution must have been due to a depletion of the chalk water, because the rainfall was normal. If they could show that depletion was already going on, and that they had already suffered, then they made out a strong case that they should not be put into a worse position.

The Chairman said that, as far as that went, it was relevant; but they must not get into some side controversy with the Company.

Mr. Bidder pointed out that Lord Robert Cecil, in this evidence, was going to make an allegation against one of the Companies with regard to the supply of water, and the reasons for it; and to draw deductions as to the effect of their pumping. It was quite obvious—whether he was right or wrong—that the Companies had their own views upon the question; and if the evidence was to be heard on one side, it would have to be heard on the other.

The Chairman said that might be; but he could not stop the evidence in general terms.

Witness then gave evidence that the rainfall from 1891 to 1894 was 12 per cent. above the average; and that, notwithstanding the excess of rainfall, there was difficulty in obtaining water from the chalk, and the streams were running dry.

Mr. Pember complained that, according to the forms of the House, he had no right to cross-examine the witness; and it was a little hard that a witness should be allowed to make an attack on one special Company on a perfectly collateral issue, and also to go behind the findings of the Royal Commission.

The Chairman put the question to Mr. Hopkinson, as to whether his evidence was consistent with the findings of the Royal Commission, and elicited the reply that it was not.

Mr. *G. B. Hudson*, M.P. for the Hitchin Division, stated that the inhabitants of the county felt very strongly on the question of the abstraction of water by the Companies who had deep wells, by which their water was taken away.

Mr. Pember said that this evidence had better be stopped upon the threshold. These questions were thoroughly discussed before the Royal Commission, who came to the conclusion that a certain amount of water could be obtained from the chalk in excess of the present quantity.

The Chairman said that Mr. Pember had said enough already to counteract whatever "poison" there was in the last answer of the witness.

Mr. Pember said that he also wanted to point out that nothing must be done or suggested with a view to altering the Bills.

Lord Robert Cecil said they did not want to alter the Bills, but to reject them; they did not think them capable of alteration.

Witness said that living on the banks of the Lea for the last thirty or forty years, he had kept a pretty close observation on the amount of water. During the last eight or twelve years, there had been great diminution; and the land and farms in the neighbourhood of streams had been greatly depreciated in value.

Mr. Worsley Taylor stated that a special meeting of the London County Council had been arranged for the following Monday, when the form of the alternative arbitration clause would be decided upon; and he promised that copies should be supplied to the opponents as early as possible.

Mr. Lewis Coward, for the Surrey County Council, said that, although that body had come to an agreement with the promoters, they were still strong opponents to the Bills, unless the agreement were scheduled to the Bills. He therefore claimed the right to put Mr. Halsey, the Chairman of the Surrey County Council, in the box, especially as the agreement had been so vehemently attacked by other opponents.

Mr. Bidder, Mr. Pember, and Lord Robert Cecil all objected, and said that, as the Surrey Council had come to an agreement, they had no further right to intervene in the proceedings.

The Chairman said he was not very familiar with the practice on this point; but he would consider it before the Committee met again, and advise himself as well as he could on the subject. If the Committee came to the conclusion that the Surrey County Council had a right to be heard, they would be glad to hear them.

The Committee then adjourned till the following Tuesday.

Eighteenth Day—Tuesday, June 25.

Mr. Balfour Browne to-day brought up the alternative clause which had been agreed upon at the special meeting of the London

County Council on the previous day. He said he did not propose to discuss it, as he understood, from the decision of the Committee, that, when clause 6 came to be considered, it would be open for Counsel representing the Water Companies to propose amendments. He would only remark that he believed the clause carried out the decision of the Committee. It read as follows:—

And whereas (failing agreement as to sale and purchase), in order to determine the fair and reasonable value of the undertaking, it is intended to provide that the Arbitrators should, in determining such value, have regard to all the circumstances of the case, and should hear and consider all matters, whether past, present, or future, laid before them by either party relating to any such circumstances, and should not be precluded by any legal objection from entertaining the same: Be it therefore enacted—There shall be paid by the Council for the transfer of the undertaking such a sum of money as the Arbitrators determine to represent the fair and reasonable value of the undertaking, together with such further sum as the Arbitrators may award to meet the cost of reinvesting such money, in the event of no arrangement being made by the Council under which such money may be reinvested without cost; and the Arbitrators, in order to ascertain such sum, shall inquire into and consider all the circumstances of the case and the contentions of the Council and the Lambeth Company respectively, and may deal with the same or any of them in such manner as they, in their absolute and unfettered discretion, think fit, on such terms and in such manner in all respects as they think fair, reasonable, and expedient, and as fully and effectually as could be done by Act of Parliament. The Arbitrators may at any stage of the proceedings under the reference to them, and shall, if so directed by the Court or a Judge, state in the form of a special case any question of law arising in the course of the reference; and any question of law so stated shall be for the determination of the Court, subject to all right of appeal as from a judgment or order of the Court.

Mr. PEMBER said that, though Mr. Balfour Browne treated it as a matter of clauses, he regarded it as one of preamble, because of the particular form which the preamble took when it specified that the transfer was to take place upon the terms and conditions contained in the Bill. Therefore the clause became part of the preamble; and as part of the preamble, he should claim to treat it.

Mr. BALFOUR BROWNE said he was not going to preclude Mr. Pember from dealing with it as part of the preamble; but he did not propose to discuss it then, as he had closed his case on the preamble.

The CHAIRMAN remarked that it was only necessary for him to say at present, on behalf of the Committee, that they were glad the County Council had been able to meet their request by having the clause prepared for that day's sitting. He would not at present express any opinion as to whether it did or did not carry out the decision of the Committee, as he had not had an opportunity of considering it. But with regard to the question of preamble, Counsel would remember that the Committee reserved their decision as to whether or not they would, in any shape or form, postpone the preamble, with the view to having the matter of clause 6 discussed; and when the case for the petitioners for the Bill was closed, they would take this into consideration. Since the last meeting of the Committee, he had had the advantage of the advice of the authorities on the question whether the County Council of Surrey had a right to be heard at this stage. He was informed that, as they had been present through all the proceedings, and had gone through the necessary forms to keep themselves before the Committee, they were entitled to be heard then on their petition. But they must confine themselves strictly to the terms and objects of the petition; and so far as they had changed their ground since, by entering into an agreement with the promoters, they could not be heard on any matters touching the agreement.

Mr. POPE suggested that, apart from the question of whether clause 6 should be discussed on the preamble or on clauses, the Committee should first of all consider whether, in truth, the new clause now brought up by the promoters did carry out, or was in harmony with, the intimation of the Committee. He said the view of his clients was that it was directly contrary to that intimation. He invited the Committee to look at the clause, to see whether it did not go behind the intimation of the Committee—and, in fact, in the teeth of it—and raise over again practically the question which the Committee had already decided.

The CHAIRMAN said he thought it better that they should conclude the matters they were discussing on the last day before they turned their attention to the clause.

Mr. POPE observed that he only intervened because he was anxious it should not be said that they allowed the Committee to slip into a course of procedure which they might have prevented if they had intervened at the time.

Mr. *Edward J. Halsey*, the Chairman of the Surrey County Council, was then called. In reply to Mr. LEWIS COWARD, he detailed the steps which had been taken, in conference with other local bodies in the county, on the water question. Their policy was that, while not in any way antagonistic to the idea of municipal control of the water supply for London, they would oppose to the utmost any attempt to deprive Surrey of the complete and independent control of its own water supply, by which he meant not only the means of distribution and the sale of water in bulk, but also the sources of supply.

Mr. LEWIS COWARD asked the witness if he considered that the agreement they had made with the London County Council carried out this policy.

Lord ROBERT CECIL objected that the question was not a proper one.

The CHAIRMAN overruled the objection; saying that they could not go into the agreement at all, as it was not referred to in the petition.

Witness (continuing) said the main reasons which dictated the policy of the Surrey County Council were that they would resent the authority of another Council within their county, which would result if the Bills were passed as they stood. Another reason was that they could see no justification for what might possibly, and probably would happen—viz., that the area of Surrey at present supplied by the Lambeth and Southwark and Vauxhall Companies would hereafter be drawn in to bear some of the expense of procuring a further supply for the County of London. They must have the absolute right to the water, to the pumping, to the reservoirs, and to the filter-beds.

The CHAIRMAN hoped Mr. Halsey would understand that the Committee would have been very glad to hear him, both for the personal assistance which he might have given them, and also on behalf of the Council, if it had been possible at another stage; but, owing to the course of matters, the Committee had, he said, been obliged to keep a tight rein upon all evidence.

Witness said the only thing he resented was that the agreement had been attacked by neighbouring local authorities with whom it had nothing to do; and they were obliged to sit and listen to the attacks, and to hold their tongues.

Mr. BALFOUR BROWNE said he had a right to cross-examine the witness. But Mr. Halsey was an opponent he was not afraid of; and therefore he did not propose to exercise that right.

Mr. BATTEN then addressed the Committee on behalf of the Waltham Holy Cross Urban District Council in opposition to the Bill. He asked the Committee to give an intimation to the promoters that the urban authorities round London, who represented the districts in which the population was growing, and which would be the London of the future, should have not only the bare pipes and mains, but also their own sources of supply. Waltham was a perfectly self-contained district, and quite capable of supplying its own inhabitants with abundant water of the purest character, obtained from its own district. The clauses of the Bill which provided for the giving back of water to the urban districts by the London County Council were perfectly illusory.

Dr. *J. D. Priest*, the Medical Officer of Health for Waltham, and Mr. *W. Beck*, the Chairman of the District Council, gave evidence in support of these views.

Mr. MORTON, on behalf of the Corporation of West Ham, said they did not desire, if it were possible to avoid it, to oppose the principles of the measure so far as they related to the claim of the London County Council to be the Water Authority for the County of London; but they had a strong objection to the Council being the Water Authority for West Ham. Negotiations had been going on between the promoters and the West Ham Corporation which had not arrived at a precise or definite result; and, under these circumstances, he was anxious not then to go into the case for West Ham, as it might have the effect of preventing these negotiations coming to a satisfactory settlement. The quantity of water proposed to be supplied in bulk—viz., 35 gallons per head per day—was ridiculously inadequate for West Ham, as two factories last year took 250 million gallons; and it would be impossible, as the Bill was drawn, for the borough to exercise the compulsory powers given to it.

This having concluded the case for the outside authorities,

The CHAIRMAN asked Mr. Pope whether he wished the Committee at this stage to express an opinion upon the new clause of the Council before the case for the Companies commenced.

Mr. POPE said it was not upon the merits of the clause, but upon the fact, which might be more or less a demerit, that it did not carry out the intimations of the Committee.

Mr. BIDDER proceeded to refer to previous discussions in the Committee, to show that the clause was not in harmony with the previous decision of the Committee, when

The CHAIRMAN (interposing) said it was rather a matter between the promoters of the Bill and the Committee.

The room was then cleared, and the Committee consulted in private. On the re-admission of the parties,

The CHAIRMAN said: The Committee have given to the clause which has been submitted to them such consideration as was possible in the short time it has been before them. Of course, it must be understood, in the first place, that any adoption of this clause which we may now signify is subject, as we said originally, to the decision we may arrive at after we have heard Counsel for the opponents of the Bill with reference to it. But on the question which we have been asked to answer—viz., as to whether this clause, as submitted to us by Mr. Balfour Browne just now, does give effect to the decision which we arrived at—speaking generally, and subject to further consideration, and also to one or two points to which I wish to call attention, we do not see anything at present in the clause, as submitted to us, which is inconsistent with the decision already arrived at as to clause 6. But I should like again to emphasize what I have said, that we, of course, have only been able to give it hasty and cursory consideration; and there may lurk in certain of the words some meaning which we do not at present see. I should also like at once to call attention to one or two points. First, it will be remembered that we were very emphatic in saying that we wished the Arbitrator to have it in his discretion to accept all the evidence, if any, and to give such effect, if any, to the considerations submitted to him as he in his discretion should deem right. At the present moment, we are inclined to think that it will be necessary to put some words into the clause, when we deal with it as a clause, and when we come to the clauses, which will make it amply clear that it is to be for the Arbitrator to decide, when any matter is submitted for his consideration, how far he will go into evidence, and whether he will go into evidence at all upon it. That we wish to have made quite clear. Further, we wish to guard ourselves against expressing, at the present moment, any opinion upon the words which refer to the discretion of the Arbitrator—"as fully and effectually as could be done by Act of Parliament." The Committee have not as yet had this matter discussed before them; and, of course, they are not to be taken as agreeing to those particular words until the matter has been fully discussed before them. But, speaking generally, the opponents of the Bill (subject to the observations I have made, and to any further observations which we may have to make upon it, which do not occur to us at present) must deal with it as being a clause which does substantially carry out the intention and the decision of the Committee. I say again that the opponents of the Bill are at liberty, in dealing with the clause, to advance such arguments as they may think fit against the clause generally, or any part of it, and that we will listen to such arguments with an open mind. The Committee have also come to this decision, at least: At present they see no objection to going into this matter as one of preamble; and they think, on the whole, that it would be a more convenient course than postponing the preamble, as was suggested, I believe, by Mr. Pope. Of course, it will be for Counsel to suggest, and the Committee to adopt, when we come to clauses (in case we should come to clauses), any verbal alterations which may be necessary.

Mr. PEMBER then addressed the Committee for the Lambeth, the

East London, the Grand Junction, and the West Middlesex Water Companies. He said that, though the eight Companies had been for a long time—sometimes thoughtlessly, and sometimes purposely—maligned, they had done their full duty to London, and had provided it with an abundant supply of excellent quality, and at a cost which compared very favourably indeed with that at which water was supplied to other great towns in the United Kingdom. It was a misfortune for the Companies that their *apologia* had never been made before Parliament, and never seemed likely to be made, for, all through the parliamentary proceedings in past years, they had been prevented from defending their position; and he wished now clearly but respectfully to protest at being compelled to resign their position as the Water Authority. But, if it were advisable for the great Metropolitan communities (which he should have been amply prepared to contest) to reverse the present system of water supply, no one could deny that it was a matter of the deepest concern that it should be equitably brought about. There was no hurry in regard to it, and no need to adopt crude, any more than unfair, methods. It was a matter of the most serious import to thousands of persons who had invested their money in the shares of the Companies. They had heard a great deal of talk about rich Companies fattening upon the consumers, and of this being a contest between the representatives of those consumers on the one hand, and a group of wealthy Companies on the other. This was only clap-trap, and clap-trap calculated to work very widespread injustice. The Companies were composed, in the main, of small and presumably poor holders, who had invested their savings at high premiums and at low rates of interest. Learned Counsel then criticized the action of the promoters in dividing the scheme into eight Bills, and proceeding with two only. He urged that they should be debarred from purchasing any one or more of the undertakings without acquiring the whole; otherwise the Council would be able to compete with the Companies left outside.

The CHAIRMAN said it might shorten matters if he were to state the decision which the Committee some time ago arrived at—viz., that they would be disposed to put such a clause in the Bill, should it be passed. Of course, he could not at present pledge himself to the particular terms of the clause.

Mr. PEMBER then submitted that the proposal for the transfer of the works before payment was made or the price fixed upon, was one which the Committee ought not to sanction.

The CHAIRMAN expressed the hope that the Companies and the Council might be able to agree as to the price, as it would save an enormous amount of time and money.

Mr. PEMBER said that perhaps he was wrong in absolutely despairing on that point; but, at the same time, he was entitled to say that the contingency of non-agreement must be provided for.

The CHAIRMAN: Oh, yes.

Mr. PEMBER said the proposal of the London County Council was absolutely contrary to the most elementary principles which regulated transactions between man and man.

Before Counsel had completed his address, the Committee adjourned till the following day.

Nineteenth Day—Wednesday, June 26.

Mr. PEMBER continued to-day his address on behalf of the Lambeth and other Companies. He stated that the proposal to acquire the undertakings before the price was fixed or paid, was unprecedented; and to say this was hardly to characterize it with proper effect. What was there to make this case differ from others of the kind, except that it was a much larger purchase in money value than most similar purchases had been? But this did not take it out of the ordinary category; it only made it a conspicuous instance of the category. Gas undertakings of great magnitude had been bought very frequently indeed, and so had important water undertakings; and both would be bought very frequently again. But, so far as he knew, no one had ever yet discovered that entry before payment, and even before the value of the property was ascertained, had ever been found necessary to avoid confusion. He asked the Committee to consider the injustice which such a provision would entail. The London County Council were to enter into possession of the water undertakings, their plant, their premises, their reservoirs, their mains. All would be theirs for months and years. Just think how they, as hostile owners, pending the arbitrations which the Companies would have no power to press on, and which were to last from six to ten years, might so manipulate the concerns as to damage them in a physical and material sense, so as to diminish the amount eventually to be paid for them. He did not wish to be supposed always to be holding up the London County Council as monsters of iniquity; but he said the Water Companies ought not to be subject to such a chance as the one proposed, and ought not to be so put into their power. Further, by clause 14 of the Lambeth Bill, from and after the date of transfer, they were to hand over to the Council "all the books, accounts, and documents of the Company relating to, and necessary for, the conduct and management of the business of the undertaking." It was just those books which ought to belong to the Company; and if any access to them was to be given, it would be given with a certain amount of jealousy and of environment such as an Arbitrator or a Court of Law might determine. This was an absolute reversal of the proper position of the two parties. Then it must be remembered that the only persons the Company could employ in the inspection of the books would be strangers; for under section 20, they were to take away all the Companies' servants. Of course, the very interests of those men would all be transferred with the transfer of the undertaking. Their sense of allegiance would be naturally towards their new masters, their permanent masters for the future—those to whom they would have to look for the chance of retaining their situations, and whom they would be bound to serve loyally, carefully, and zealously, for the purpose of retaining those situations. To offer the Company their services for the purpose of arbitration would be simply a mockery. Such a process was an illustration of the monstrousness of the clauses which necessitated it, because it was one of the many clauses of the Bill which arose solely and entirely from the determination on the part of the Council to ask for transfer before payment, or even before the ascertainment of value. The learned Counsel also criticized the clauses of the Bill which prohibited the increase of officers' salaries and the entering into contracts unless with the consent of the Council. On the latter point, he said there had not been a single contract made since 1894 with the consent of the Council. They had no more right to consent to contracts made by the Water Companies than to consent to those which he might have made with a builder to repair his own house. The West Middlesex, the East London, and the Southwark and Vauxhall Companies last year obtained parliamentary powers to raise sums of money from £300,000 to £400,000 or £500,000, for the purpose of increasing their mains, for improving their filtration, and for enlarging their storage; and peremptory clauses were put upon them to commence the works at once. These works had been begun; and very large contracts, involving hundreds of thousands of pounds, had been entered into since July, 1894, which, under the ill-considered clause in this Bill, would be absolutely annulled. It seemed to him incredible that people who had to settle not only on the basis of equity, but of common sense, should put in such a clause as that. He thought, however, that he saw the object of it. One of the charges made against the Companies was that they were deficient in filtration and storage works; and if the Council could invalidate the contracts, they might go to the Arbitrators and say that the Companies were deficient in these works, and that they had no means of improving themselves because all the contracts they had entered into since July, 1894, had come to an end. Supposing the Bills should be "hung up" for the next five or ten years, were the Companies to wait an indefinite time for the improvement of their storage and filtration, while the Council made up their minds to act, and perhaps might never make up their minds to act at all. Referring again to the arbitration clause, he asked why the shareholders in the Water Companies should be picked out to be the victims of an untried, novel procedure, the result of which no one could forecast. The ordinary form of arbitration in such cases was that of the Lands Clauses Act. He admitted that, under that form of arbitration, Arbitrators generally gave something on account of compulsory sale; but if such an enhanced sum was given, it was intended to cover delays and difficulties, and possible slight losses on reinvestment. The 10 per cent. was a creature of the imagination; for no one knew really the enhanced value which an Arbitrator had in his own mind. Of course, the enhancement of value would be a large sum on a transaction of 30 or 40 millions of money; and if it involved one big cheque being paid *en bloc* to some huge financier, something might be said against the question being taken into consideration by the Arbitrators. But in this case there would be some 14,000 or 15,000 people among whom it would have to be divided; and each of them would stand to lose something in the way of brokerage upon the reinvestment.

Sir J. KITSON asked if he understood Mr. Pember to assert that there was no custom which had established a particular percentage.

Mr. PEMBER replied that he did not think there was. It might be very likely that Arbitrators, by a sort of rule-of-thumb, added 10 per cent. in their own minds; but that it was an absolutely universal custom was not true. The London County Council kept harping upon the special necessity of protecting the purchaser, or, as they put it, the public of London. He granted that the public of London ought not to be robbed; neither surely should the shareholders in the various Water Companies. It was not the Companies who were the aggressors, but the London County Council. All the Companies asked was to be left alone; and therefore, if any special protection were needed, it was for the Companies and not for the London County Council. But no special protection was needed for either. There were no special features in the case; and therefore the transaction should be left to the operation of the general law. He referred to the discussions in the London County Council on the subject, and to the observation of Lord Onslow that to lose the clause, either in form or in substance, was to make London pay what it considered a "fool's price" for the undertakings. In other words, London had suggested to itself a point of value at which it would be worth while to buy the water-works; and anything beyond this they would consider a "fool's price." Therefore they must have the protection, in meal or in malt, which clause 6 would give them—that of preventing the Arbitrators from assessing against them a higher price than they were prepared to give. The learned Counsel again urged that the arbitration should be left open under the Lands Clauses Act, and that the alternative clause did not carry out the declarations of the Committee. He asked the Committee to take care lest the last performance of the London County Council should beguile them, and induce them to do, under cover of what they called "innocent words," as great an injustice as could possibly be done under any question as to compulsory purchase and sale. As the conditions of the clauses were part and parcel of the preamble, he asked the Committee to reject the Lambeth Bill as embodying a crude and an unfair scheme for carrying out what might or might not be a desirable change in the water supply of London.

Mr. LITTLER, for the Kent Water Company, said they were in an entirely different position from all the other London Water Companies. Everybody had admitted the admirable administration and the excellence of the supply of the Company, who had been decided against, in a matter essential and vital to their own interests, without having been fully heard. This had arisen partly from the actual condition and difficulty of the matter itself, and partly from the conduct of the public authorities. But they felt that it mattered little to them, if they were to be executed, whether they were hanged or disposed of by some other method. What they felt was that, up to the present time, since 1881, and then only partially, because there had been an agreed scheme between the Water Companies through Mr. Smith and the then Government, they had never been completely heard; and even before Sir Wm. Harcourt's Committee, the whole question was never discussed. It had been more or less necessary for Committees to follow the course which had been invariably taken, of stating that they did not propose to discuss this, that, and the other question, all of which were vital to the Company's existence. Therefore, he felt that he was, to some extent, fighting the matter with one hand tied behind his back. If the question were open from the beginning, whether or not the undertaking of the Kent Company was to be bought, and whether or not it was wise, in the interests of the population of London itself, that it should be bought, he had abundance of evidence.

But he wished respectfully to state at the outset that, whatever might be the view of any other Water Company, the Kent Company most emphatically and distinctly protested against being acquired by anybody. A more unjust, a more carelessly worded, a more improperly drawn Bill than that now before the Committee could not very well have been drawn. To present such a Bill must have been an advised piece of work for the purpose of destroying the property which it was his duty to protect. From end to end it was full of indications of this purpose, which he trusted would never be accomplished. Why were the Kent Company dragged into the matter at all? They supplied water to an enormous area outside London, and to a very small area inside. With one single exception, every Director and principal officer was either a Kentish man or man of Kent. That the Company were accidently partly within the County of London was no fault of theirs; and the proposal to acquire the undertaking was an injustice to the county for whose benefit they had spent their money. It was perfectly true that, at the present moment, it was a very profitable speculation; but it was not so at first—no water company was. They spent their money with the desire of providing a thoroughly effective and proper supply for the district in which the then and present shareholders were mainly interested. They had done their duty thoroughly; and because it so happened that Parliament had thought fit to include a portion of the district within the County of London, they were asked to take part in all these enormously expensive proceedings, and so have their property taken from them in a method which was only justified by the most eminent public interest. If the Committee were going to lay down the principle of first compelling them to part with their property, and secondly to part with it on terms which were not justified by existing law, they were laying the foundation for the deprivation of all those rights of property which, from the time of the Romans onwards, had been recognized as being the very first principles of existence of any intelligent and properly civilized state. It was, in this view, a far more serious question than the mere case of the Kent Company that was before the Committee. The Committee had said, what he had fully anticipated would be their decision sooner or later, that the matter must be dealt with as a whole. But he respectfully submitted that the Kent Company ought not to be part of the whole. Whatever they did with the other Companies, they ought to say that, as regards the Kent Company, there was no reason whatever why they should be worried, tormented, and harassed by further proceedings. If the London County Council were to purchase the works of the Metropolitan Water Companies, the Kent Company ought to be no part of the scheme. If, however, the Council hereafter wanted the 30 square miles which they had in London, then let them do as other people had done—by agreement purchase the mains and pipes if the Company chose to sell them. But there had been no case ever presented to Parliament of compelling a water company, or any other company to part with their rights while they were behaving properly. Why were the London Water Companies to be made an example of? Not because London was badly off, not because it was suffering, for it was the most healthy of all the great towns of England. There was no public necessity, but only a "fad" or a fancy. There was an idea which people were pleased to call "municipalization of water;" and he supposed gas and railways, and everything else, would follow in due course until private capitalists would have nothing to invest in. The Kent Company was one which could stand before Parliament, or anywhere else, and face comparison with any supply in England, be it municipal or by a company, whether for charges, for quality, for regularity, or for propriety of conduct. This was admitted on all sides, even by the promoters, and by the Kentish authorities. Under these circumstances, he was entitled to criticize every line of the proposals under which it was sought to buy them up—proposals which were absolutely unparalleled so far as the Kent Company were concerned. The proposal to acquire the undertaking was not in the interests of those for whose benefit it was established—the people resident in Kent—but for the purpose of securing water for London to the detriment of the Kentish people. If the promoters would consent to strike out the Kent Company, he would not have a word more to say. He submitted that the Committee should declare that there had been no reason shown for the purchase of the Kent Company's undertaking at all, and that therefore they were out of it, not only now but for all time. He hoped that one result of the present inquiry might be that they might be left to do their own beneficent work in their own way, and in their own district.

At this point of the learned Counsel's address, the Committee adjourned till the following day.

Twentieth Day—Thursday, June 27.

Mr. LITTLER continued to-day his address on behalf of the Kent Company. He pointed out that there was no power taken by the London County Council in the Bill to raise money for the purchase of the undertakings. He knew of no case of a Purchase Bill in which the authority seeking to purchase did not also take care to provide the necessary money to carry it out; and this provision was all the more essential after the decision of the Committee that the undertakings were to be bought as a whole. The Committee were therefore asked to sanction these two Bills for the purchase of the undertakings of the Lambeth and the Southwark and Vauxhall Companies without there being any certainty that there would be ever any authority to purchase the rest, and without the faintest notion of whether or not any purchase whatever could be carried out. They had no power to compel the Council to come before Parliament and promote a Bill for the purpose of raising the money; and if they found the arbitration was going against them, it might be that they would abandon the whole thing, on the ground that they had no money. Supposing they thought the undertakings could be bought for £15,000,000, and their value was £40,000,000 (which, unless absolute confiscation was to take place, was the least amount likely to be found by the Arbitrators), were the Committee going to allow them to spend their money and put upon the ratepayer £600,000 a year by way of sinking fund, if the ordinary term of 60 years was allowed? But by the Council's Money Bill they asked for 100 years.

Sir J. KITSON asked where the 100 years was stated.

Mr. LITTLER said it was in the Council's Money Bill.

Mr. FREEMAN denied that such a provision was in the Money Bill.

Mr. LITTLER quoted the clause to that effect. He objected to the transfer of the undertaking before payment; and he urged that the arbitration should be conducted under the Lands Clauses Acts, instead of any special clauses being inserted in the present Bill. He saw the same vices in the alternative clause submitted by the Council as were contained in the original clause which the Committee had rejected; and he expressed the opinion that, unless the Council had seen that the same purpose could be effected by it as by the clause they fought so hard to retain, they would never have proposed it.

The CHAIRMAN called attention to the words in the clause with reference to the sum to be awarded by the Arbitrator to meet the cost of re-investing, and said that the Committee, when they expressed general approval of the clause, had not in their minds what the particular effect of such words might be.

Mr. PEMBER contended that it might have the effect of excluding from the mind of the Arbitrator the possibility of his taking into account any other element beyond the cost of reinvestment. He proceeded to criticize the clause in regard to the way in which the officers and the debenture-holders of the Company were to be dealt with; and he concluded by again urging that there was no reason why the Kent Company especially should be purchased by the London County Council.

Mr. BALFOUR BROWNE, at the request of the Committee, gave the reasons for his contention that the new clause was in harmony with the decision of the Committee; stating that by it the Arbitrator would be able to arrive at the value of the undertaking, and have regard to "all the circumstances of the case" with a free hand. He intimated that any words which the Committee thought were in derogation of that view the promoters would be willing to amend.

The Committee then consulted in private. On the readmission of the parties,

The CHAIRMAN said the view they took at present of the alternative clause was that it substantially carried out the decision of the Committee, subject to a probable alteration in the preamble of it (which he understood Mr. Balfour Browne did not object to, though the Committee did not wish to bind him), and also subject to an alteration which would make it quite clear that the words "such sum as the Arbitrator may award" and the following words did not in any way fetter or reduce the power of the Arbitrator to consider fully whether he should give any and what sum, or the question of whether any "addition shall be made to the fair and reasonable value of the undertaking in respect of compulsory sale," if in his discretion he should think fit to do so. Their object was to leave the Arbitrator as perfectly unfettered as could be with regard to this question. The Committee also reserved for further consideration the final words of the paragraph—viz., "and as fully and as effectually as could be done by Act of Parliament." But in other respects they thought the clause carried out substantially the decision at which the Committee arrived some time ago. As to their further proceedings, it was clear to all that if the dissolution of Parliament was to take place within the period generally expected, it would be a mere waste of time and money to attempt to conclude the consideration of the Bill in such a way as to enable it to be taken up again in the next Parliament at the stage at which they broke off. Therefore he thought it would be hopeless to proceed further with the investigation in the present Parliament. At the same time (all things in politics being uncertain), the Committee could not exclude the possibility of some change taking place in the political situation. Therefore they would adjourn till Wednesday; and if it should then appear that there was no prospect of a prolonged session of the present Parliament, such as would enable them to get the business through, they would not attempt to do it.

Mr. BALFOUR BROWNE said it was a great pity the Committee could not hear these Bills out, as the remainder of the proceedings could not take very long. If the preamble were found to be proved, in all probability the opponents would not discuss clauses; and then the Bills could be suspended at a stage when they could be taken to the House of Lords in the following session.

The CHAIRMAN said the Committee had considered this matter, and had come to the conclusion that there was no prospect of their being able to arrive at a final decision as to the preambles of the Bills within the time which appeared to be at their disposal.

The Committee then adjourned till Wednesday (to-morrow).

Rushden and Higham Ferrers District Gas Company, Limited.—At the recent annual general meeting of this Company, the Chairman (Mr. Paul Cave) read the Directors' report, which stated that the net profit realized in the year ending March 31 last amounted to £1085; being an increase of £464 on the preceding twelve months. The sale of gas produced £4009, as compared with £3431—being an augmentation to the extent of 18 per cent.; and the receipts from residual products and the profits on gas-fittings were also higher. In pursuance of the policy indicated in last year's report, £414 of the amount available on the profit and loss account had been appropriated in reducing the cost of the two old undertakings at Rushden and Higham Ferrers respectively; and there was left a sum of £745 for dividend, which the Directors recommended the shareholders to declare at 6 per cent. on the paid-up capital. A dividend after this rate would, according to the Company's Articles of Association, entitle the shareholding consumers to a bonus of 1d. per 1000 cubic feet of gas consumed by them during the past year up to a maximum consumption of 10,000 cubic feet for each share held. Dividend and bonus together amounted to about £623; leaving £122 to be carried forward. Reference was made to the loss sustained by the Company by the death of their Manager, Mr. John Lewis, and to the appointment of Mr. J. T. Lewis, of Wellingborough, as Managing-Director of the Company, and of his brother (Mr. H. C. Lewis) as Deputy-Manager. The Directors had decided to reduce the price of gas 2d. per 1000 cubic feet as from March 31 last; and in adopting this policy, they said they were persuaded that, while a reduction would be a material boon to consumers, the increasing consumption would more than compensate the Company. The report was adopted; and the dividend recommended was declared.

LEGAL INTELLIGENCE.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

Thursday, June 27.

(*Before Lords Justices* LINDLEY, LOPES, *and* RIGBY.)

The Ventnor Gas and Water Company v. The Local Board of Health for the District of Ventnor.

This was an appeal from a decision of Mr. Justice Kekewich, delivered early this year, and reported in the JOURNAL for Jan. 29 (p. 225), whereby he declared that the defendants were not entitled to take water without payment, for the purpose of watering the roads, &c. from the mains of the plaintiffs, excepting from those constituting what was termed the "low-level" system.

Mr. WARMINGTON, Q.C., and Mr. HAMILTON appeared for the appellants; Mr. CRIPPS, Q.C., and Mr. BRAMWELL DAVIS, Q.C., represented the Company.

There are in Ventnor three levels of water-mains, indicated respectively by the colours red, blue, and green. The last are the highest; and they were laid entirely by the Company. The red are the lowest; and they were laid by the late Mr. Livesay under an agreement with the then Improvement Commissioners of Ventnor, and were purchased from him by the Company in or about the year 1866. The blue occupy an intermediate position in both respects. The chief contest was as to the green; the defendants contending that, under the terms of the agreement made with Mr. Livesay in 1858, they, as successors of the Improvement Commissioners, were entitled to take water free of charge from any mains of the Company, who succeeded Mr. Livesay; and further that, even if they were not right as to these pipes, they were entitled to take water from those indicated by the colour blue.

Mr. CRIPPS pointed out, on behalf of the Company, that no question had been raised before Mr. Justice Kekewich as to the mains marked blue.

There being considerable difference between the Counsel on each side as to the facts with reference to these mains,

Mr. *J. G. Livesay* was called to give additional evidence with regard to them.

The further hearing of the case was then adjourned.

Friday, June 28.

On the resumption of the proceedings,

Lord Justice LINDLEY intimated that their Lordships were of opinion that the order as made by Mr. Justice Kekewich was slightly too wide; and that, subject to anything Counsel might say, they proposed to make a declaration that the defendants were not entitled, under the agreement of 1858, to take water for any purposes from any mains of the plaintiffs laid by them under their parliamentary powers, and not under the agreement, or in substitution for mains laid by Mr. Livesay under the agreement, or with the consent of the then Improvement Commissioners. If this were accepted in principle, the better way would be for the Junior Counsel to make it plain, with reference to the map attached to the agreement, by means of letters, what portions of the mains were excepted from the declaration, as having been put down by Mr. Livesay under the agreement.

After some discussion, the order was made in this form; each of the Lords Justices giving a short judgment in which he pointed out the reasons for his decision.

Lord Justice RIGBY said the leading consideration was this: That, by the 4th section of the agreement, the Commissioners were to be entitled from time to time to place fire-plugs on any of the main pipes that Mr. A. F. Livesay had used for supplying the inhabitants of the town with water He said he did not think this could be cut down to any of the main pipes the liberty to lay which was granted by the agreement; for the 8th section clearly contemplated their extension beyond the limits of the express grant. The real question at issue was what main pipes belonged to Mr. Livesay. Anything that never belonged to him was altogether outside the agreement; but everything that did belong to him—and the dividing-line must be the time when the Act came into operation—was, in his judgment, within the express terms of the 4th clause of the agreement. The plaintiffs were entitled to the costs of the action; but, as they had put their rights rather too high, and the defendants had, to some extent, succeeded on the appeal, there would be no costs of the appeal on either side.

It was then arranged that, if the Junior Counsel could not agree on the exact limits of the blue mains from which the defendants were entitled to draw water, Lord Justice Rigby should give his assistance.

HIGH COURT OF JUSTICE IN IRELAND—CHANCERY DIVISION.

Thursday, June 20.

(*Before the* MASTER OF THE ROLLS.)

Alliance and Dublin Consumers' Gas Company v. Corporation of Dublin.

This was an action instituted by the Alliance and Dublin Consumers' Gas Company against the Corporation of Dublin, to have the award made in December, 1889, in regard to the meters attached to the public lamps, carried into execution, and specifically performed by the defendants. They also applied for a mandatory injunction to compel the defendants to remove all defective meters from the public lamps, and to provide, in lieu thereof, proper meters within the meaning of the award, for the purpose of ascertaining the consumption of gas supplied by the plaintiffs to the defendants, and for an inquiry as to the damages sustained by the Company by reason of the defendants' breaches of the award.

Mr. W. KENNY, Q.C., Mr. RONAN, Q.C., Mr. GORDON, Q.C., and Mr. A. F. BLOOD appeared for the plaintiffs; the SOLICITOR-GENERAL, Mr. O'CONNOR, Q.C., and Mr. PHILIP O'C. WHITE represented the defendants.

Mr. KENNY, in stating the case, said the action was the last incident in a course of litigation which had existed for some years between the Gas Company and the Corporation with reference to the public lighting of the city. He wished he could express with confidence that the present was the last of a long series of actions; but, having regard to the difference and the correspondence which had taken place, he could scarcely venture to do that. Legal proceedings had been taken from time to time for the purpose of recovering from the Corporation the amount of the monthly account for the consumption of gas in the public lamps of the city. There had likewise been several arbitrations. He thought he might venture to say that in all cases the Company had been uniformly successful. The Company were incorporated in 1866; and, by the Act passed in that year, they were empowered to contract with public authorities for the supply of gas for public purposes. Down to 1890, the Company remained the owners of the public lamps and lamp-posts in the city; and they supplied the meters to the lamps—the average being one to every ten lamps. Prior to 1889, various disputes arose between the Company and the Corporation as to the public lighting of the city; and, in order to settle the differences, they were referred eventually to Mr. A. G. Vernon Harcourt and Mr. H. E. Jones. The Arbitrators decided that the Company should sell the plant to the Corporation at a certain price, and that in future the Corporation should supply the meters for the purpose of measuring the gas. The price of the plant was subsequently fixed by arbitration at £14,341. It then became the duty of the defendants to provide and fix the new meters; and accordingly the plaintiffs wrote to them on Jan. 17, 1891, requiring them to provide the new meters. On Dec. 7, 1891, a reply was received, stating that they had given orders for ten new meters, and that they would be fixed to the lamps in a reasonable time. But, notwithstanding, the Corporation, up to July, 1891, had only provided and fixed six new meters. In that month more were put in. But the plaintiffs complained about them; pointing out that they were so defective in their construction, and of such insufficient capacity, that they ceased from time to time to register the quantity of gas furnished to them, to the great loss of the Company. In consequence of these complaints, the Corporation had to remove several of the lamps. From September, 1892, up to the present time, the Corporation had persisted in fixing meters of the same type as those which were removed as being defective, with the result that the Company were losing heavily. They had endeavoured to induce the Corporation to agree with them as to the appointment of an Arbitrator to decide the question whether the meters provided by the Corporation were proper meters within the meaning of the award. No settlement, either as to the question to be submitted to arbitration or the person to be the Arbitrator, had been arrived at; and after a considerable amount of correspondence, the Board of Trade refused to appoint anyone, as the parties could not agree to the reference. The Corporation had now fixed 188 new meters; and, by careful examination and taking readings of the quantity of gas consumed at different times, the Company were convinced that all of them were of defective construction and insufficient capacity, and that many of them from time to time passed gas without registering it, and were in other respects improper. The Corporation, in their defence, said that the award in question provided that the Company should make arrangements for a proper testing-place for the gas; and that they had failed to do so. The Corporation also denied that they were guilty of any delay in providing the new meters according to the award. The Corporation immediately took over the lamps, and put themselves in communication with the makers, and asked them to send in a tender for 200 meters—being about the number required. Their tender was accepted by the Corporation; but it was considered advisable that, before getting a consignment of the entire number, a few samples should first be tried in actual working. These were accordingly sent to the Corporation, who had them fixed to the lamp-posts. The Company objected to them as not being proper meters within the meaning of the award. This led to correspondence between the Corporation and the Company, and interviews between their respective representatives; and it was not until Oct. 6, 1891, that the Company, as the Corporation alleged, withdrew their objections. This they did by a deputation, who met the Gas Committee of the Corporation; and, after discussion and explanation, expressed themselves satisfied with the meters as supplied. The Company did not at the interview agree to the meters. The Corporation further said that the changes necessary took some time; and they averred that the alterations were effected within a reasonable period, and that the meters were of a proper character. Some of them, they said, had to be removed; but it was solely for repairs consequent on injuries caused by want of care and by ill-usage during the operations of watering and testing. Some few of the meters, they admitted, might have failed to register correctly; but this must, they said, necessarily occur from time to time in any large meter system. The Corporation added that they were willing to submit to arbitration the matters in controversy between themselves and the Company; but the Corporation considered that the question proposed to be submitted was only part of the controversy which had been, and was still, taking place with reference to the consumption of gas. The Company, they said, had not complied with the arrangements made as to the gas-testing station and the apparatus in it. The Corporation complained that the Company had refused, and continued to refuse, access to a material and necessary part of the testing-place; that the supply of gas to the station was not adequate; that the testing-station was not properly heated and ventilated; and that the Company used an old pattern of photometer of an unreliable and condemned type, useless for the proper testing of the illuminating power of gas.

The MASTER of the ROLLS remarked that he did not think this had anything to do with the present case.

Mr. KENNY, continuing, said the Corporation averred that no proper arbitration could be held with reference to the gas-testing station. They likewise averred that they had complied with the award, which required that the meters should be the manufacture of one of two firms, and that they were proper meters within the meaning of the

award. They further said that the action had been caused solely by the refusal of the Company to include a material and necessary part of the dispute; and that the action should be dismissed with costs. Counsel proceeded to deal at length with the facts of the case, and read the correspondence between the Corporation and the meter-makers, and between the Corporation and the Company. He stated that they would produce as witnesses Mr. Cotton, the Company's Secretary and Manager, Mr. William Sugg, of London, and Mr. Frank Wright, a gentleman who was named in the award as one of the firms to supply the meters, and who would confirm Mr. Sugg's evidence. They would also examine Mr. Livingstone, a gas expert, and the Surveyor to the Vestry of St. George's, Hanover Square, and another expert. In conclusion, he asked his Lordship to grant the injunction.

Friday, June 21.

To-day, evidence was given on behalf of the Company.

Mr. *W. F. Cotton*, J. P., detailed the negotiations that proceeded between the Corporation and the Company in the matter of the constant complaints made by the latter as to the defective meters supplied. He objected that the meters were wanting in capacity, and did not properly register the gas that passed through them. He believed that 90 per cent. of the meters, if now examined, would be found to be out of order.

Mr. *M. Doolin*, the Company's Lighting Inspector, testified to the accuracy of the returns made by him as to the condition of the meters.

Mr. *J. Cotton*, the Assistant Secretary of the Company, proved the accuracy of a return prepared by him, giving the results of the examination of the new meters since they were introduced by the Corporation, from the official returns and from correspondence which had passed between them and the manufacturers. From this return, he estimated that 159 out of the 203 meters supplied were defective.

Mr. *G. Livingstone* stated that he was present on the previous Wednesday at an examination of ten of the meters in different streets in the city; and it was found that nine of them were defective. He considered the meters entirely unsuited for the average meter system.

Mr. *W. Sugg* considered that meters of the size and capacity of those in Dublin were utterly useless for the purposes of the average meter system.

Additional evidence for the plaintiffs was given on the following day, and their case then closed; the further proceedings being adjourned.

MARLBOROUGH STREET POLICE COURT—Friday, June 28.

(*Before Mr.* J. L. HANNAY.)

The Gaslight and Coke Company v. Dowling.—Unlawfully Laying a Gas-Pipe and Removing a Meter.

Two summonses which had been issued against Mr. J. L. Dowling, of 24, Tottenham Court Road, at the instance of The Gaslight and Coke Company, were heard to-day. In one, the defendant was charged with having, on or before April 24 last, laid, or caused to be laid, a pipe communicating with a pipe belonging to the Company, without their consent, and contrary to the Gas-Works Clauses Act, 1847; and in the other case, he was charged with having removed a meter by which the Company's gas was registered, without giving them notice, contrary to the provisions of their Private Act of 1868, section 64. The summonses were taken together.

Mr. W. O. HODGES (instructed by Messrs. Bedford, Monier-Williams, and Robinson, of 6 and 7, Great Tower Street, E.C.) appeared for the plaintiffs; defendant conducted his own case.

Mr. HODGES, having explained the nature of the two summonses as stated above, said there was no charge of fraud against the plaintiff. Quoting the sections of the Acts governing the summonses, Counsel pointed out that a portion of section 18 of the Gas-Works Clauses Act, 1847, ran as follows: "Every person who shall lay, or cause to be laid, any pipe to communicate with any pipe belonging to the undertakers, without their consent, ... shall forfeit to the undertakers the sum of £5 for every such offence," &c. The case under this section was this: Mr. Dowling entered into a contract with the Company for a supply of gas; and the meter, in the first place, was put in the basement inside his house. On March 26 last, when the register of the meter was taken, the meter was in its original position; but, on April 24, one of the inspectors called to again take the index of the meter, and found it had been moved from the basement to the area outside, and that the Company's pipe from the main which ran to the inlet of the meter had been cut off, and a fresh one connected with the meter in the area. Then, in the second case, section 64 of the Company's Act of 1868 provided that, before any person connected or disconnected a meter by which the Company's gas was registered, should give not less than twenty-four hours' notice, in writing, to the Company; and any person failing to do this, was liable to a penalty not exceeding £5. Counsel proceeded to call his Worship's attention to a case which was decided on the first question in the Queen's Bench Division in 1885, to show that it was not necessary to prove fraud, though in part of the section the word "fraudulently" is used. It was sufficient to show that a pipe had been connected with the Company's pipe. The Court, in giving judgment, said: "Although there had been no waste or misuse of gas, or any fraud or injury, the appellants were liable as they had connected without the Company's consent." Therefore it would be sufficient for him to show that a connection had been made in this case without the consent of the Company; and that in the second case the meter had been moved.

Mr. *Vincent*, one of the Company's employees, gave evidence to the effect that, when he called at Mr. Dowling's in March, the meter was in the basement; but on April 24, it had been moved into the area. When the meter was in the basement there was only a short length of inlet-pipe; but after it had been shifted to the area, there was about 8 feet of inlet-pipe.

Witness was cross-examined by defendant to show that the area was covered in, and communicated with the basement.

Mr. *Gitson*, one of the Company's Inspectors, stated that, in consequence of a report by the last witness, he visited the defendant's premises, and saw the meter in the new position, which was exterior to the house wall. The defendant had given no notice to the Company with reference to the fresh connection. On April 26, he drew defendant's attention to the serious liberty his gas-fitter had taken in disconnecting the Company's service-pipe, and re-fixing the meter. He requested that the work should be altered, and asked who had executed it. He could not get any information from the defendant, or replies to the letters which he had written on the subject.

In cross-examination, witness said he was not aware that, on the 3rd of May, a letter was written to the Company by defendant, complaining of an escape of gas, and that a man was sent to look after the matter.

Defendant said a great deal turned upon this point. There was no doubt there was an escape of gas; and they could not ascertain where it was. A gas-fitter was sent for; and he said the meter was in a dangerous condition and should be moved. In the letter he (defendant) had received from the Company's inspector, the liability was fixed on the gas-fitter.

Mr. HANNAY: But you know you are the master.

Defendant (proceeding) said that, the escape continuing, on May 2 he wrote to the Gas Company; and on May 3, they sent a young man to look at the meter. He told him (defendant) that the meter was a very old one; and he would take the index and have the meter tested. In consequence of this escape, his account was 100 per cent. in excess of the usual amount. When the Company's man examined the meter, he said it leaked.

Mr. *Gitson* stated that the meter was only fixed in 1888; and there was no leakage from it until after it had been moved.

Defendant: The date on the meter is 1875.

Mr. HANNAY said there was no doubt there had been an infraction of the law in both cases; and each party appeared to have assumed rather a haughty manner. He should impose a penalty of £3 in each case, and on one summons he would allow £2 2s. costs, which would make in all, with the summonses, £8 6s.

Question as to the Payment of Water-Rates.

In the Lord Mayor's Court last Tuesday, an action brought by the East London Water Company against Mr. J. Childs, of Cleve House, Boleyn Road, Stoke Newington, to recover £32 4s. 2d., water-rates due from him for certain houses and stables in Pelham Street, was heard by the Recorder (Sir C. Hall, Q.C.). The only defence raised on the pleadings was that the Court had no jurisdiction; and Mr. Ruegg, the Counsel for the defendant, argued that, inasmuch as there was no contract that the rates should be paid in the City, the plaintiffs were bound to sue in the County Court of the district in which the houses were situate, and where the rates were payable. Mr. Lewis Glyn, who appeared with Mr. George Kebbell for the Company, argued that water companies were not bound to collect their rates, which were payable at the office, wherever it might be. He quoted the decision of Mr. Justice Charles in the case of *The Northern Stone Company v. Gibney* in support of this contention; and, proceeding, he said that if a consumer omitted to fulfil his obligations, the cause of action arose in the district in which the creditor's—in this instance the Water Company's—office was situate. In the present case, the Company's office was in the City, and therefore part of the cause of action arose within the City; and this gave the Court jurisdiction in cases under £50. The Recorder held that the defendant was bound to pay the rates at the Company's office; and said the fact of his not having done so, gave the Court jurisdiction. He therefore decided for the plaintiffs for the amount claimed.

Reduction of the Central Middlesex Water Company's Capital.

In the Chancery Division of the High Court of Justice last Saturday, a petition asking the Court to confirm resolutions which had been duly passed for reducing the capital of the Central Middlesex Water Company, Limited, came before Mr. Justice Stirling. Mr. Ingle Joyce said the Company was incorporated with a nominal capital of £32,000, divided into 3200 shares of £10 each. Only 1500 shares were issued; and these had been fully paid up. Not long ago, there was a legal transfer of part of the undertaking to the Colne Valley Water Company, in respect of which £10,250 was paid to the Central Middlesex Company. The capital being in excess of their requirements, it was proposed to distribute the sum of £7500 by paying back £5 per share on the 1500 shares. Resolutions authorizing the reduction had been duly passed. His Lordship sanctioned the reduction, and dispensed with the further use of the words "and reduced" after one week.

The Automatic Coal-Gas Retort Company, Limited, v. The Newcastle-under-Lyme Corporation.—We understand that this action, to which reference was made in the JOURNAL on April 9 last (p. 764), has been settled by the defendants withdrawing their opposition to the Company's patent rights, and paying the royalty in full.

The Public Lighting of the City of London.—At the meeting of the Commissioners of Sewers of the City of London last Tuesday, the Streets Committee presented a report relative to lighting, by means of electricity, the smaller streets in the City. They submitted a report from the electrical inspector thereupon, and recommended that the experiments therein suggested be made, the City of London Electric Lighting Company charging only the actual cost to them of the work, estimated at about £386. The Court approved of this suggestion, and instructed the Committee to carry it into execution. A letter was read from the Incandescent Gas-Light Company, offering to supply their lights, which, they stated, were being employed for similar purposes in Berlin, Paris, and other Continental cities, and had proved highly successful. Their system, compared with electric lighting, was, they added, about one-eighth of the cost. It was resolved to refer the application to the Streets Committee for consideration and report.

MISCELLANEOUS NEWS.

THE EXAMINATIONS IN GAS MANUFACTURE.

The Pass List.

The following are the names of the successful candidates in the last examinations in "Gas Manufacture" by the City and Guilds of London Institute:—

HONOURS GRADE.

First Class.—Cornish, J. H.; Lewis, G. P.; Milbourne, R. J.

Second Class.—Adderley, A. F.; Cuthbert, A. G.; Dickinson, E. G.; Dunn, M.; Guiver, J. N.; Hislop, L.; Kros, G.; Pettigrew, W. E.; Pye, J. H.; Richmond, C.; Riley, H. E.; Saville, A. E.; Shadbolt, F.; Strivens, C. J.; Watkins, J. T.; Weippert, E. D.; Wilde, W.; Wilson, A.; Winter, F. J.

ORDINARY GRADE.

First Class.—Barnett, W. A.; Brooks, A. E.; Golding, H. A.; Hallaway, J. P.; Mott, W. J.; Nield, W.; Tagg, S.; Tarratt, F. P.; Tiffen, J.; Tully, T. S.; Wicks, G.; Wise, F.

Second Class.—Archer, W. H.; Askew, S. G.; Bingley, J., Booth, R.; Brown, W. E.; Buckley, A. E.; Butterworth, J. T.; Copeman, E. J.; Glenny, G. W.; Jackson, T. J.; Jennings, G. L.; Mansfield, E. A.; M'Combie, H. J.; Marston, A.; Mitchell, H. V.; Napier, J. W.; Ovens, W. D.; Parsons, F.; Price, W. H.; Ralph, G.; Ross, G.; Slater, J. H.; Sutcliffe, P. S.; Sykes, F. C.; Thompson, A. M.; Wildman, J. R.

We learn from the Superintendent of Technological Examinations (Sir Philip Magnus) that the prizes have not yet been awarded.

The Question Papers.

The following were the questions put to the candidates by the Examiner (Mr. Alfred Colson, M.Inst.C.E.):—

ORDINARY GRADE.

1. Describe the process of carbonization, and give a sketch and description of a through clay retort. 2. What process immediately follows carbonization? How is it effected, and with what results? 3. What is the usual treatment of coal gas for the removal of ammonia? 4. Enumerate the chief impurities contained in crude gas, and state how their presence may be detected. 5. Describe a method of freeing gas from sulphuretted hydrogen. 6. What is the use of the exhauster? 7. How is the illuminating power of gas ascertained? 8. Of what service is the inferential jet photometer? 9. How would you test spent oxide for sulphur? 10. For what purposes are the station meter and governor employed in gas-works; and how is the latter regulated?

HONOURS GRADE.

1. Describe the principles of the chief methods of heating gas-retorts. 2. Give an outline sketch (elevation) and description of a setting of eight retorts, with fittings. 3. What kinds of coal are most valuable for gas-making, and why? 4. Give a sketch (plan, elevation, and section) and description of a purifier fitted with three tiers of sieves. 5. In what way would you estimate the quantity of ammonia, sulphuretted hydrogen, and carbonic acid in coal gas? 6. Give a description, with outline sketch, of an untrussed two-lift gasholder and puddle tank, and explain the difference between the latter and a rendered tank. 7. Describe a process for manufacturing sulphate of ammonia from ammoniacal liquor, pointing out what precautions should be taken in order to prevent nuisance. 8. Describe some system of stoking machinery, and state what advantages it may have over hand labour. 9. Describe some method of enriching gas other than by means of cannel. 10. What is the difference between a flat-flame burner and an Argand? In what respects do these differ from an incandescent burner; and what advantages may be claimed for each?

LANCASTER CORPORATION GAS SUPPLY.

Reduction in Price—The Quality of the Gas.

At the Monthly Meeting of the Lancaster Town Council last Wednesday, the Gas Committee submitted a resolution recommending a reduction in the price of gas to consumers within the borough (other than to consumers having prepayment meters) to 2s. 6d. per 1000 cubic feet, subject to a discount of 10 per cent. upon payment within one month from delivery of the account, and also to 2s. 6d. for gas supplied for public lighting within the borough, subject to a discount of 20 per cent. upon payment of the account within one month of delivery. The minutes contained an extract from a report made by the Manager (Mr. C. Armitage) in 1893 with reference to the quality of the gas, and complaints as to the blackening of ceilings.

Mr. N. W. HELME, said he had pleasure in moving the confirmation of the minutes of the Gas Committee, especially as, after most careful consideration with the Manager, as to the position of the undertaking, and a comparison of the profits of last year with the estimate for the ensuing year, the Committee were able to recommend that which was half promised when the price of gas was advanced owing to the increased price of coal—viz., that they should, as soon as possible, reduce the price. They now recommended that the price should be reduced 3d. per 1000 cubic feet within the borough; and they proposed to give a further reduction to the Lighting Committee for the purpose of developing the lighting of the town. It would be within the recollection of the Council that the opinion was some time ago expressed that the Committee should address themselves to the production of a better quality of gas which would not blacken consumers' ceilings so much as that which had been supplied. In the minutes was an extract from the report presented by the Manager in 1893, with reference to the quality of the gas; and to that report he especially directed attention, because in view of these facts he wished to point out that the increased use of cannel would not give freedom from blackened ceilings. In largely increasing the amount of cannel used in gas manufacture, they would without doubt improve the illuminating power of the gas they supplied; but it would not have the other effect. It would cost about £1200 a year for extra cannel to increase the illuminating power; and in facing this question of the provision of an additional £1200 a year out of revenue for the purpose of giving a brighter light, the Committee felt the public would prefer to have gas of the quality at present supplied, if at the same time they could have a reduction of 3d. per 1000 feet. The gas at present sent out compared favourably in regard to illuminating power with that of seventeen other provincial towns from which returns had been obtained. There was only one place in the country where better gas was supplied, and that was Liverpool. At Lancaster they used 31·82 per cent. of cannel; and the average at the other places was only 14 per cent. In regard to the illuminating power, they stood at Lancaster at between 19 and 20 candles; while 17·45 candles was the average of the other towns he had taken. The question might be asked whether it was desirable, in the interests of the department, that the reduction in price should be made. Last year they had a net balance to credit of £4550 on the basis of a charge of 2s. 9d. per 1000 cubic feet. This year they required £1100 extra to be put aside for the new sinking fund; which would allow them to provide, during the next 44 years (that being the equated period decided upon) the sum necessary to cancel the increased charge upon the undertaking, owing to the financial operations in getting rid of the irredeemable debt and converting it into a redeemable one. If the Council sanctioned this reduction, it would cost £1855. They would have to make full provision for the legitimate maintenance of the works and mains; and they had taken out the average cost in that matter. Since 1880, the average cost of maintenance had been £888. But last year they spent £922; and in addition, for maintenance of mains, £347 was expended, whereas the average amount for the latter since 1880 was £230. Therefore on both those heads they had put aside last year £200 more than the average of previous years. Then last year they paid out of revenue £697 for the laying of new mains—a charge that might strictly have been put to capital account. If the Corporation would put aside such a sum as would fairly allow of the fabric of the gas undertaking being maintained up to the standard required, in view of further possibilities in the shape of extensions, he thought they would be justified in making the reduction, having regard to the desirability of giving the public gas at the lowest possible cost, consistent with the financial obligations of the Corporation. At any rate, the figures he had quoted should leave them £1000 a year which could be devoted to the relief of the rates, and a further balance, which the Committee would strive to increase, of £500, which the Council could deal with as they thought fit. If they desired to hand over £1000 to the relief of the rates, he thought there would be another £500 by which, if they were desirous of doing so, the work of the sinking fund could be accelerated, so as to pay off the capital liabilities in a shorter period than 44 years.

Mr. BOWNESS seconded the motion.

Alderman GILCHRIST said he was disposed to allow the reduction of the price on the distinct undertaking that, if the Gas Committee failed to convey to the borough fund the sum of £1500, after paying all costs of maintenance and liabilities, the price must at once be raised again to 2s. 9d. It was a question for the Council to consider whether they would endeavour to accelerate the reduction of the debt, or they would undertake the grave responsibility of repaying it upon the scale propounded. This was the first time the Gas Department had yielded such a net profit to be disposed of in the way contemplated. During the last fifteen years, the profits had amounted to £29,000; and the Corporation had never derived anything from them except a sum of £636 and another of £500. They were now entering upon a calculation which had never been verified in the past; and this was a venturesome thing to do. They had increased the debt of the undertaking by the addition of something like £30,000; and it seemed to him that the wisest course for them to pursue would be to endeavour to break the back of that debt, and get it under £100,000. He had been pleased, and he thought the Council had reason to be gratified, with the activity displayed recently in trying, if possible, to put the undertaking on a better footing than it had been for years past; but he thought this reduction might have been with safety deferred until they saw the product of next year or the year after.

Mr. HELME said the policy had been carried out for several years of assigning the profits to what had practically amounted to a development of the capital value of the undertaking. They had paid for £23,000 of capital expenditure out of revenue during the time the concern had been in the hands of the Corporation. Originally the old Gas Company spent £37,000 on capital account; the Corporation had since expended £26,473—making a total of £63,473. The Company received a premium of £50,000 for the sale of the undertaking; and the Corporation had had to pay £22,743 for the conversion of the irredeemable stock and mortgages, so that they had a gross liability of £136,216. On the other hand, they had £23,000 of increased value on the undertaking, paid out of profits; and the result was that the works and plant were in first-class order, and capable of producing and distributing 150 million cubic feet of gas per annum.

The minutes having been agreed to,

Mr. HELME announced that the reduction would take effect at the end of next quarter.

PLYMOUTH GAS COMPANY.

The Annual Meeting of the Plymouth and Stonehouse Gas Company was held last Thursday—Mr. G. HENDERSON, in the chair.

The report for the year ended March 31 last stated that, after payment of the authorized dividend in January, there remained to the credit of the profit and loss account £23,908, from which the Directors recommended the payment of a dividend for the half year ending March 31 last of 6½ per cent. on the ordinary stock, 9s. 9d. per share on the additional shares, and 9s. 3d. per share on the new shares, free of income-tax. This would absorb £6331, and leave £17,577 to be

carried to the credit of the next account. The Directors reported that the Bill promoted by them in the last session of Parliament for enlarging the powers of the Company received the Royal Assent on Aug. 25, and that the £50,000 of 3 per cent. debenture stock authorized by the shareholders in February last had been subscribed. In order to meet the increasing demand for gas throughout the district, it was, the Directors said, necessary to erect an additional gasholder, and they had accordingly entered into a contract for one capable of holding 2 million cubic feet, which would be available for the coming winter. The balance-sheet showed that the total amount of the stock and share capital authorized was £235,000; and of debenture stock, £70,000. The stock and share capital paid up was £125,000; the premiums received amounted to £30,000; and the debenture stock, to £50,000—a total of £205,000. The expenditure on capital account to March 31, 1894, was £144,786. Since that date, the additional expenditure had been £42,423, of which £42,013 was on account of new buildings and manufacturing and storage works, £207 on new mains and services, and £203 on meters. The balance on capital account was thus £17,709. From the revenue account, it appeared that the receipts were: From the sale of gas, £60,001 (of which £54,844 was from private consumers, and £5157 for public lighting); from meter-rents, £3478; residuals, £21,698; transfer fees, £9; interest, £249—total, £85,436. The total expenditure was: Manufacture, £59,823 (including coal, £43,204); purifying materials, &c., £1642; salaries, £1165; wages, £9938; repairs and renewals of works of plant, £3863; distribution, £3945; public lamps, lighting and repairs, £1112; rents, rates, and taxes, £1984; management, £3192; law and parliamentary charges, £1791; other small items, £563—total, £72,412, and leaving a balance of £13,024 to carry to profit and loss account. The coal account showed that 68,000 tons of coal and 1510 tons of cannel were carbonized during the year. The production of coke was calculated at 44,973 tons, of which 11,715 tons were estimated to have been used on the works. The sales of residuals were: Coke, 32,258 tons; breeze, 2173 tons; tar, 692,870 gallons; and sulphate, 541 tons.

The CHAIRMAN, in moving the adoption of the report and balance-sheet, congratulated the shareholders on the continued increase in the consumption of gas. During the past year, the quantity registered was, he said, 666 million feet—an increase on the previous year of 38 million feet. As the shareholders knew, difficulties had been experienced in starting the new retort-house. Most of the men in the employ of the Company were Union men; and they did not take kindly to the introduction of machinery for charging and drawing the retorts—in fact, they did everything to prevent it being a success. The dampers were constantly tampered with, so that the heats might be diminished, and the Company prevented from making the usual quantity of gas per ton of coal; and, of course, that mischief must have been done by somebody who knew what he was about. On one occasion, an attempt was made to wreck one of the large gasholders; and this, if it had been successful, would have meant the loss of some thousands of pounds to the Company. An attempt was also made to interfere with one of the governors; but fortunately that mischief was discovered in time to save part of the town from sudden darkness. Referring to the subscription of £50,000 of 3 per cent. debenture stock, the Chairman said it was a proof of the confidence the public had in the security of the Company. The Directors applied for some of that stock; but, as the total applications exceeded the amount to be issued, they failed to get what they wanted. The erection of a gasholder, 120 feet high, was being carried out; and in this way the Directors were anticipating the requirements of the district. During some months last winter, they had great difficulty in meeting the increased demand for gas, in consequence of the lack of sufficient storage. This involved an additional cost to the Company. During some weeks, the increase in the demand amounted to 2,000,000 cubic feet over the corresponding periods of last year. In future, however, the Company would be able to meet any increased demands. Adverting to the balance-sheet, the Chairman said the income from the sale of gas had amounted to £60,001, showing an increase of £3335 over last year's receipts. There had also been a slight increase in the meter-rental. The residual products compared very favourably with previous years—£21,698 having been received, as against £20,831 in 1893-4. The interest was slightly less than last year, on account of the Company's inability to secure the usual discount off the coal contracts. The total receipts had been £85,436, against £81,642—an increase of £3794. With reference to the debit items, coal had cost more; the increase being £3514. Salaries of officers and labourers had only been £9983, against £10,625—a decrease of £642, notwithstanding the large increase in the quantity of gas produced. This was due to the machinery introduced, which, it should be added, had not yet been fully utilized. There had been an increase in rates and taxes. As to the future, it was hoped that, during the coming year, better terms would be secured for the supply of coal; and if only a difference of 6d. a ton was obtained, it would mean £1500 or £1600 to the benefit of the Company. The new retorts and gasholder would also effect considerable savings, and would fully justify the expenditure.

The resolution was carried.

The retiring Directors and Auditors having been elected, thanks were accorded to the Directors and officials for their services.

ELECTRIC LIGHTING NOTES.

Financial difficulties are again troubling the St. Pancras Vestry. The Electric Light Department require another £75,000, in order to settle bills due on account of the construction of the King's Road central station and dust destructor. A few weeks since, a Special Committee was appointed to consider and report upon the question of issuing 3 per cent. bonds, guaranteed by the rates, for all future loans. The report was adverse to the proposal; and Dr. Bell, the Chairman of the Finance Committee, last Wednesday moved that the money be borrowed from the London County Council in the usual way, as the cost of negotiating the public issue would be too large. He said Counsel had advised: (1) That the Vestry would not be able to issue bonds at a discount; (2) that there was no hope of their price being advanced; and (3) that the amount required was too small. The last reason will afford food for reflection for the St. Pancras ratepayers. Mr. Barnes dissented. Why, he asked, should not all the debts of the Vestry be paid off by means of the proposed bonds? They would be as safe to the investor as Consols or the Bank of England. He moved, as an amendment, that the question be deferred, and the probable cost of negotiating such a public loan as suggested be presented at the next meeting of the Vestry. In spite of Dr. Bell's protest that the money was required immediately, the amendment was carried. The appointment of a Chief Electrical Engineer was next proceeded with. Out of 56 applications, three candidates had been selected—Mr. Sydney W. Baynes, Mr. Henry R. J. Burstall, and Mr. B. Deakin. Mr. Sweet, the Chairman of the Electric Lighting Committee, announced that at their meeting the first-named gentleman obtained 17 votes, and the other two 13 each. Mr. Doll asked why their present Engineer was not among the selected three candidates. As it was, he would have to teach the new man his duties. No answer was vouchsafed to this question. Mr. Dixon asked whether Mr. Sweet had been in communication with Mr. Baynes prior to the advertisement being issued. Mr. Sweet was understood to say that he certainly had been introduced to him. The questions submitted to the candidates had not been suggested by one of themselves. The candidates then attended the Vestry, and questions were put to them by the members. Several of them were, however, ruled out of order, including one by Mr. Dixon as to who introduced Mr. Baynes to Mr. Sweet. Mr. Baynes, who is now with the Corporation of Bradford, was ultimately appointed, at a salary of £600 a year.

In view of the near approach of the completion of their works for the supply of electricity, a little handbook has been issued by the Walsall Corporation, giving a description of the system, and the uses to which electricity may be applied. The high-tension continuous current system, with transformers, has been adopted. The station is situated on the site of the old gas-works in Wolverhampton Street. Three large Parker dynamos, coupled direct to Chandler engines, supply a continuous high-tension current at 2000 volts, which is carried to three sub-stations in the town, where it is transformed down to 105 volts. Two sets of batteries at one of the sub-stations will furnish current during the hours when the load is light. The cost of supply will be 6d. per Board of Trade unit, which, it is stated, will work out, under ordinary domestic conditions, to half as much again as gas at 2s. 6d. per 1000 cubic feet, when giving an equivalent amount of light.

A large extension of the electricity distribution system is about to be undertaken at Portsmouth; and the present installation of 100 arc lamps in the streets is to be increased by 250 lamps. This is an easy way of improving the finances of the department; and possibly the ratepayers, who will have to bear the additional burden, may have something to say on the matter when they learn the extra cost in comparison with the existing system of gas lighting.

The orders which the Electric Lighting Committee of the Halifax Corporation have in hand for current have compelled them to contract for a 300-unit dynamo, to be coupled direct to a 600-horse power vertical engine. The new plant will more than double the present motive power—500 horse.

The York City Council last Tuesday considered a report of the Electric Lighting Committee, recommending the acceptance of the tender of the Electric Construction Company, of Wolverhampton, to supply the necessary plant and fittings for an installation for the sum of £10,865, and an application to the Local Government Board for sanction to borrow £15,000 for the purpose. The scheme proposed is known as the Oxford system. There were three other tenders, as follows: Siemens Bros. and Co., £10,345; Brush Electrical Engineering Company, £8360; Messrs. C. A. Parsons and Co., £10,266. It was resolved to refer the matter back to the Committee, with instructions to ascertain from the four Companies on what terms they will supply the city with electricity, and work the plant for a number of years.

An appeal to the Assessment Committee as to the rating of the electric lighting works at Bristol revealed some interesting figures. The assessment returned stood at £3000 gross, and £1850 rateable value. The Committee were asked by the Corporation representative (Mr. Wise) to reduce the estimate to £1745 gross and £1428 net. The account on which his figures were based showed that the number of private lamps fixed on Dec. 31 was 15,000; and an increase of about 2300 was estimated for the present year. The average revenue per lamp was 6s. 11½d., which would yield £6062. Deducting discounts, the net revenue of the private lamps would be £5880. The quantity of electricity supplied to the street lamps (90) came to 150,417 units, which equalled, at 6d. per unit, £3760; and the discount left the net revenue from the street lamps at £3008, and the gross from all sources at £8888. The cost of production totalled to £5808; and subtracting this from the gross gave £3008 as the net income. The tenants' share of revenue and landlords' deductions, further reduced the total to £2061, from which had to come rates and taxes at 6s. 8d. in the pound, amounting to £516, which brought down the net annual value of the whole undertaking to £1545. Inasmuch as the works were situated in two poor-law unions, with a gross of £676 outside this authority, Mr. Wise asked the Committee to reduce the assessment to £1428. Inquiries had been made in various quarters to ascertain the amount at which electric light stations were assessed; and in no case except Manchester did it approach to anything like the sum which was put down on the Bristol undertaking. In Manchester, where the works were assessed at £2500, there was a supply of 439,000 units, as against 293,000 units in Bristol. The entire cost, including meters, was £82,000; and at present the undertaking was not paying. For the year 1894, the rate-in-aid was £7000, which included the public lamps, from which no revenue was derived. The Committee, after hearing the other side, concluded to leave the parties to arrange the gross value, and to fix the rateable value at £1500.

New Reservoirs for Leeds.—The Leeds Corporation Water Committee have resolved to recommend the Council to purchase between 9 and 10 acres of land, which has been offered to them by Lord Cowper's agent for £3600, and which is required for one of two new service reservoirs it is proposed to construct.

THE LONDON COUNTY COUNCIL AND THE WATER COMPANIES.

The New Arbitration Clause.

A Special Meeting of the London County Council was held on Monday last week—Mr. ARNOLD in the chair—for the purpose of considering the report of the Parliamentary Committee with reference to the new arbitration clause proposed to be inserted in the Water Transfer Bills, to carry out the views expressed by the Hybrid Committee of the House of Commons to whom two of those Bills have been referred. An abstract of the report and the text of the clause were given in the JOURNAL last week (p. 1388); and they came before the Council accompanied by a recommendation that the draft clause be tendered to the Committee in substitution for the provisions relating to the terms of transfer which stand in the Bills.

Mr. T. M'KINNON WOOD, the Chairman of the Parliamentary Committee, in moving the reception of the report, said he did so with an unusually grave sense of responsibility. This proposal for the purchase of the water undertakings was opposed by some members of the Council in the interest, as they alleged, of the ratepayers. These gentlemen seemed to regard the ratepayer as a being possessed of a pocket, but having no interest beyond it. He himself preferred to regard him as an ordinary human being, with many other interests not less vital. His anxiety was that the ratepayer should pay no more for the undertakings than they were justly worth, all things considered; while at the same time he did not desire that he should pay less. As to the clause now before the Council, the objections to it came from those very people who had all along opposed the transfer. They did not like the clause before; and now that it was altered, they, in effect, said it must be dropped because the conditions to which they formerly objected were now removed. There were two courses before the Council—either to proceed with the Water Bills or drop them—and he held that counsels of delay only came from those who wished to have the whole matter shelved.

Mr. C. A. WHITMORE, M.P., moved the following amendment: "That, as the conditions under which the purchase of the Water Companies would be carried out under the proposed new clause are essentially different from those which have been sanctioned by the Council in clause 6 of the Lambeth Water (Transfer) Bill, the Finance Committee be directed to report upon the probable financial effect upon the rates of London of a purchase of the Companies under these altered conditions; and that the Water Transfer Bills be not further proceeded with until this report has been presented to the Council." He said it was perfectly true that he was opposed to the policy of purchasing the water undertakings; but he ventured to urge the wisdom of the amendment upon those who were in favour of the purchase, and who yet wished to exercise reasonable precaution in the conduct of the transaction. He contended that the past policy of the predominant majority on the Council had been opposed to the idea of the compulsory purchase of the water undertakings; and he quoted extracts from previous reports bearing out this view. The only way in which he could account for the change of opinion was that they had persuaded themselves that they could invent a scheme of arbitration whereby they could buy the water undertakings at a much less sum than that which had been anticipated. This was to be done by making the arbitration not an unlimited and unrestricted or fair one. His amendment asserted that there had been a change in the arbitration clause. The clause, as now proposed, he believed to be a fair one, and one which they all ought to be willing to support; but it was vain to suppose that the alteration which had been made was not an essential alteration. By this clause, the Arbitrator would be able to pronounce upon the matter according to his unfettered discretion; and, he contended, they ought to have some sort of information from the financial authorities of the Council as to what would be the results of this transaction. It must not be understood that the Moderates were not as ready to have a good and pure water supply as the Progressives; and they hoped, with the change in the Government and the assistance of a practical Parliament, to be able to obtain all that was necessary in the control of the Water Companies, in the interests of London, without the purchase of their undertakings.

Sir GODFREY LUSHINGTON seconded the amendment, and asserted that it was impossible to frame a clause which should give effect to the ruling of the Chairman of the Hybrid Committee and at the same time carry out the wishes of the Council.

Mr. C. HARRISON argued that the clause now proposed effectively carried out the whole of the provisions that were in the Bill as originally submitted, and that it would be impossible, in any arbitration conducted under this clause, for the Arbitrators not to have regard to all considerations which the Council might submit. Further than this, it gave him jurisdiction as to matters which he would otherwise have no power to consider; and, lastly, having that jurisdiction, he was in a position to deal with those matters as fully and effectively as could be done by Act of Parliament.

Mr. R. M. BEACHCROFT said there were three points with which the Council had to deal—first, whether the clause carried out the intention of the Committee of the House of Commons; secondly, whether it was or was not a serious departure from the original clause (in other words, whether it did or did not mean the sacrifice of a vital paragraph); and, thirdly, if that should be the case, whether it was not the duty of the Council to withdraw the Bills. Either the clause was or it was not a serious departure from the original one. If it was, then Mr. Whitmore's amendment ought to be carried; if it was not, then it was clause 6 in another form. He did not wish to use hard words; but he considered that the clause was framed in such a way as to mislead the Council as to its real meaning.

The DEPUTY-CHAIRMAN (Mr. W. H. Dickinson) contended that the amendment only took rank with the other amendments moved on previous occasions, which had for their object the postponement of the purchase. The object of the supporters of the Bills was to buy the undertakings at a fair price; but it should be a price fair to the purchasers as well as to the sellers. He repudiated the remark of Mr. Beachcroft, that the clause was framed with a view to misleading the members of the Council.

Sir JOHN LUBBOCK said he had not opposed the Bills in the interests of the Water Companies, but because he believed they would add some 4d. in the pound to the rates. He had been asked: Why should the Council not manage the water supply of London as well as the Town Councils of Manchester or Birmingham, Leeds or Newcastle? In the first place, because the problem was more complicated; and, in the second place, because the London County Council was much less numerous in proportion to their duties. If their numbers were in the same proportion to the population as those of the County Councils of the other great cities, they would have nearly 1000 members on the London Council; and then they would have time to undertake these extra duties. Hitherto the Progressive party had objected to improvements which were not in their judgment absolutely necessary, because they considered the cost would fall on the present ratepayers, and the landlords would gain the advantage. But here was a gigantic purchase, to which the same argument applied; and yet they were keen to undertake the responsibility. It was sometimes said that, by bringing the water supply under one control, a saving might be effected. But the Bills would have no such result. They would place the control of the water in the hands of local authorities; and, in the place of the eight Water Companies, they would have some twenty authorities. He submitted that, as the Companies were already paying their maximum dividends in most cases, and very near it in the others, with one single exception, it followed that all the Council could buy was the chance of a loss. In fact, they could not be any better off by purchase; and they ran a great risk. Therefore he was for control, and not for purchase. Surely one function of the Finance Committee was to supervise the finances; and it was most unwise and unbusinesslike to engage in this enormous purchase without any report from the Finance Committee as to its probable effect. He supported the amendment, because he was satisfied that the policy adopted by the Parliamentary Committee, by a small majority only, would land them in loss, and still further augment the ever-increasing rates of the Metropolis.

Mr. J. STUART, M.P., contended that all the circumstances of the cost were before him. If they paid £30,000,000 for the water undertakings, this meant £900,000 a year for 100 years. The income of the Companies at the present time was £1,150,000. Therefore it was perfectly possible for other figures to be worked out in a similar way. As to the Council being inadequate to overtake the work they had to do, he reminded the members that the work done by the Councils in provincial towns included that done by the Vestries and District Boards in London; and in the Metropolis there were upwards of 4000 persons engaged in it. He advocated the adoption of the clause as being within the four walls of what had been decided by the Committee of the House of Commons.

Dr. LONGSTAFF complained of the absence of information as to the probable cost of the scheme.

Mr. B. L. COHEN, M.P., declared himself in favour of the transfer of the water undertakings, if it could be equitably done; but he was opposed to the measure now before the Council, because he did not know what cost to the ratepayers would be involved.

Mr. M'KINNON WOOD having briefly replied,

The Council divided, with the following result: For the amendment, 52; against, 63—majority against, 11. On a further division, the recommendation of the Committee was approved by 64 votes to 36.

The Council then adjourned.

BELFAST CITY AND DISTRICT WATER BOARD.

The New Mourne Works.

On the invitation of the Chairman of the Belfast Water Board (Mr. R. J. M'Connell), a party of above 100 gentlemen visited, yesterday week, the Mourne district, from whence the new supply of water is to be obtained for the city and district. In connection with this visit, some information concerning the scheme has been published. The catchment area from which the first instalment of the water will be collected is upwards of 9000 acres in extent; but this can be greatly added to in the future. It has an elevation varying from 450 feet to nearly 2800 feet above sea-level; and the character of the catchment area is of the very finest description for a domestic water supply, consisting of high and precipitous mountain slopes, largely composed of fine granite and boulders on the surface. It is also free from cultivation and pollution of any kind, is uninhabited, and lies in close proximity to the sea. The Commissioners will purchase the whole of the lands within this catchment area, in order to preserve its present character, and prevent possibility of pollution in future. The water is collected at present by the Kilkeel and Annalong Rivers, which fall into the sea between Kilkeel and the favourite summer resort, Newcastle. The Kilkeel River will be intercepted in what is known as the "Silent Valley," by means of a large storage reservoir, having an earthen embankment some 520 yards in length across the valley, and will be upwards of 90 feet high over the present river bed. The top water area will be nearly 250 acres; and the total capacity will be 2850 million gallons. The total supply available from the whole of the Mourne district will be, when fully developed, about 30 million gallons per day. The reservoir will be formed in the usual way by an earthen embankment, with a puddle trench and a wall of the same material in the centre for its entire length. It will be faced with a thick lining of granite rubble on the water slope, and will have the necessary storm channels, weirs, water-tower, and outlet works. The supply will be drawn from the reservoir for use in Belfast through a number of large geared valves at different levels on the outlet stand-pipe, which will allow the water to pass in large or small quantities through the main outlet tunnel into the main gravitating conduit, which will be formed of concrete, having a maximum carrying capacity of 30 million gallons per day; the size being 5 ft. 6 in. by 5 ft. 6 in., with a regular fall of 18 inches per mile. The main conduit will be continued in "cut-and-cover work" along the mountain slopes to near Newcastle, where it will be carried through the slopes of Slieves Donard and St. Thomas

Mountains in a tunnel some 2¼ miles in length, which will be principally in the solid granite and silurian rocks. It will have a regular fall of 12 inches per mile, and a maximum capacity of 30 million gallons per day. Some parts of the tunnel will be at a depth of upwards of 600 feet below the surface of the ground, and can only be worked from either end and two centre shafts. The service reservoir will be made large enough to meet the demands of the city, having a storage capacity of about 80 million gallons, or eight days' supply. The service reservoir will be constructed at an elevation of 350 feet above sea-level, and will ensure a high-pressure supply to the most elevated districts within the Commissioners' area. The Commissioners have decided not to bring in the full supply available from the Mourne district at present, but will limit the first section to what will meet the increasing demands of the city for a number of years to come. The borrowing powers under the Act authorizing the works is, in round figures, £800,000.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Glasgow Corporation Gas Department have closed a year of great success. There was an output of gas of over 4000 million cubic feet—an increase over the preceding year of 260 million feet, or more than 7 per cent. This is the greatest quantity of gas the Corporation have produced in any one year. It is doubtless due chiefly to the extreme cold of last winter, which led to a very large consumption of gas for heating purposes. In that view, there is to be seen the advantage of the Corporation policy of producing a gas which they can sell at a moderate price, the success of which is being vindicated year by year. Other corporations—all the large gas-works in Scotland are now in the hands of corporations—may be expected to take note of what has been done in Glasgow, and in time to go and do likewise. Besides gas for heating, there must have also been a greatly increased consumption for lighting. It is announced that there was a very considerable portion of the increase in the central area of the city, where electric light is supplied. This points to the view that the one light leads to the other being in greater demand; and gives another proof that gas and electricity are not so much rivals as partners. There has been an increase in the demand for electricity, but not nearly in the same proportion as for gas, which thus more than holds its ground.

The Corporation have confidence in the gas undertaking; for whereas a year ago it was reported that they had carbonized 468,000 tons of coal, they have just completed contracts for the current year for 500,000 tons. Last year they did not contract for the whole twelve months. By this time of the year, the strike of the miners had begun to disturb the market; and the Gas Committee, correctly estimating what the outcome of the struggle would be, only contracted for a few months' supply, and twice afterwards during the year they were in the market. This year there is, at present, perfect tranquillity in the coal trade; and the Committee have therefore felt themselves in a position to secure a whole year's supply. In doing this, they have been able to get their supplies, taken all over, at a reduction of about 6d. per ton upon last year's rates. As compared with the prices paid two years ago, there is an advance of from 3d. to 6d. per ton for splint; and cannel is about the same as then. The price agreed upon for splint is from 6s. 2d. to 6s. 6d. per ton; offers at 6s. 8d. having been declined. Second-class cannel has been secured at from 10s. to 11s. per ton; and third-class, at from 8s. 8d. to 9s. There would seem to be some reason to expect a rise in the price of coal during the year. Of course, that is almost self-evident, prices being abnormally low; but it also has force given to it by the fact that the Corporation have thought fit to contract for the whole year, as well as by the circumstance that one former large contractor this year declined to offer at the prices going.

The Edinburgh and Leith Gas Commissioners, at their monthly meeting on Monday, resolved to purchase the undertaking of the Corstorphine Gas Company, at the price of £1850. Bailie Kinloch Anderson said that the Company valued their undertaking at £2310; but they knocked off £460. The Commissioners would not manufacture gas in Corstorphine, because they had no statutory powers to do so; and they would require to lay a 6-inch main from the end of their own mains to join the 4-inch main of the Corstorphine Company. This would cost a considerable sum; and they calculated that the interest on the purchase-money and on this outlay would be £61 10s. At present, the price of gas in Corstorphine was 5s. 10d. per 1000 cubic feet. They proposed to reduce it to 4s.; and they expected a revenue of £400 a year. The only condition in the agreement was that the Company should obtain the consent of residents in the neighbourhood to the use by the Commissioners of one of the gasholders of the Company. The acquisition of the undertaking by the Commission would be a great benefit to the residents in Corstorphine, because they would get Edinburgh gas at 1s. 10d. per 1000 cubic feet less, and the present charge of 2s. 6d. a year for meters would be abolished.

Bailie Kinloch Anderson explained the accounts of the Commission for the past year, which were given in last week's JOURNAL; dwelling particularly on the improvement there had been in the gas-stove account. Regarding the matter of the chimney at the Edinburgh works, the Clerk read a petition which had been presented to the Dean of Guild Court by the Procurator Fiscal, requesting the Commissioners to attend the Court on Thursday; and asking the Court to interdict the Commissioners from proceeding with the erection of a chimney at the Edinburgh Gas-Works without a warrant, to order them to take a temporary chimney which they have already erected, and to find them liable in a penalty not exceeding £25. It was explained, in answers which are to be submitted to the Court, that the Commissioners acted in the interests of public safety in what they did. Bailie Anderson said they could do nothing in the way of examining the large chimney until they got a temporary one erected, and every hour was precious; but the action of the Dean of Guild Court would entail several weeks' delay. Two members of the Commission—the Clerk, and Mr. Mitchell, the Engineer—were appointed to attend the Court, and defend the action of the Commissioners.

In the Second Division of the Court of Session on Thursday, their Lordships gave judgment in the action by the Magistrates of Glasgow against Messrs. Ireland and Son, coal importers, of Dundee, in which £240 3s. 5d. was sued for as the price of a cargo of coke. At the request of the defenders, the pursuers sent a box of coke to a firm in Hamburg; and afterwards the order was given to ship 900 tons of coke at Grangemouth for the Hamburg purchaser. The coke was rejected at Hamburg as not conforming to sample. Lord Kyllachy decided that the sample box never having entered into the contract, the sale was not by sample; and he gave decree for the amount sued for. Their Lordships of the Second Division have reversed that finding. Lord Trayner, who gave the opinion of their Lordships of the Second Division, said that the order for 900 tons was given as the result of the sample which was sent. He was of opinion, therefore, that the sale was by sample; and he was of opinion that the pursuers understood it to be so, because their position throughout was that the cargo did conform to sample—a position they did not need to maintain if the contract was what they contended it was. The defenders never saw the sample, and were not intended to see it; they could not therefore have compared the cargo with a sample they had never seen. It was at the port of destination only that it could be ascertained whether the cargo did or did not conform to sample. The case was continued, on account of litigation in the German Courts between Messrs. Ireland and Son and their Hamburg purchaser.

The Dunfermline Gaslight Company are to be congratulated on the success which has attended the removal of their gas-works to a new site; everything has been found to work with the greatest satisfaction. The output of gas rose from 59,634,000 to 62,429,000 cubic feet; and as the unaccounted-for gas was reduced from 17·52 to 11·18 per cent., there was 6,000,000 cubic feet more gas sold during the year. There has been improvement in everything. The greater quantity of gas was produced from 124 tons of coal less; the yield of gas having been 580 cubic feet per ton more. The revenue from gas increased from £8604 to £9710; from tar and liquor, from £651 to £947; and from coke, from £480 to £510. The yield of tar and liquor rose from 55·26 to 67·16 gallons per ton of coal carbonized. The gross profit was £3829, as compared with £3414 in the preceding year. The shareholders met on Wednesday, and adopted the report of the Directors, which recommended the payment of the customary dividend of 6 per cent. It was reported to the meeting that the Company's Manager (Mr. Hubert Pooley) was selected, in April last, to appear before the Wallasey District Urban Council, in connection with the appointment of Engineer and Manager for their gas and water undertakings; but the Directors of the Dunfermline Company, in order to retain his services, at once offered Mr. Pooley the equivalent salary to what would be paid at Wallasey, at the same time minuting their appreciation of his management. Mr. Pooley accepted the terms, and entered into a yearly engagement. The Directors did well to be generous towards Mr. Pooley, who has, ever since his arrival in Dunfermline, been engaged upon the transfer of the works, and in addition has been able to produce such good results. The Company is excellently financed, as well as managed, as is shown by the state of the capital account, and by the fact that, after the heavy outlays they have had during the past two years, they are able to place £900 to a reserve fund.

Mr. Storey, who took the leading part in the gas transfer at Falkirk, has intimated his resignation of his seat in the Falkirk Town Council, and, necessarily, upon the Gas Commission. The principal reason he gives is the state of his health. He is anxious to have rest after the worries of the past two years; but he adds that "in the public interest, also, it is perhaps as well that one who, in the discharge of his duty, incurred so much opposition, and perhaps ill-will, should now step aside, so that personal feelings may the more readily subside, and all may unite in working the gas business in the interests of the community." I fear the latter may be really the chief reason; for there is a disposition to lay the blame upon Mr. Storey of some of the disappointing features of the gas transfer. That is not as it should be, because, although Mr. Storey initiated the various steps which were taken, the whole Council must bear the responsibility of adopting them. It is almost a pity that the Gas Commission should be deprived of the services of the one who has bestowed most attention to the subject, almost as soon as they had started on their career. But everyone will echo Mr. Storey's wish that personal feelings may subside; for, where personal feelings rule, there can be no good management of a gas undertaking.

The Cambuslang Gas Company—thanks to the energy of the Manager, Mr. J. Donaldson—have just closed the best year they have ever had, and that, too, notwithstanding large losses in consequence of the miners' strike of last year. The Directors have strengthened the reserve and depreciation funds, and have given Mr. Donaldson an increase to his salary—the third within five years. They have also reduced the price of gas from 3s. 11½d. to 3s. 6½d. per 1000 feet; that used for cooking and heating remaining at 2s. 11d. The reduction in price is equal to 3 per cent. on the capital. Though situated in a mining district, the Company are fortunate in the matter of thefr unaccounted-for gas, which only amounts to 7·27 per cent.

Dundee Corporation Gas Stock has changed hands of late at the rate of £350 per £10 annuity, *ex* the half-year's interest, which is an advance upon previous business of £15.

A meeting of the Arbroath Gas Corporation was held last night, to consider the subject of working up the residual products within the gas-works. The Special Sub-Committee in charge of the subject—who, it will be remembered, recently visited Inverness to see the chemical plant in use at the gas-works there—gave in their report. It was to the effect that they found the plant being worked efficiently in very small space; and as regarded complaints of nuisance by adjoining residents, it was found that there was more smell from the changing of the purifiers than was given off by the chemical plant. They stated that spent liquor was run into the town's drains, which discharge into the River Ness; and there never had been any complaint either of polluting the water or destroying fish. The Sub-Committee recommended the Corporation to erect plant. They estimated that £400 would be ample to meet the cost; and taking the average prices they have received for residuals during the past three years, they calculated that the clear profit on the working would be £863 per annum, which would be £213 more than the average price they

have received from contractors. On the prices obtained during the year just closed, the clear profit would be £968, which would be £320 more than was received from the contractor. The Corporation unanimously approved of the report and recommendations; and the Works Committee were directed to carry the resolution into effect.

The Jedburgh Gas Company have paid a dividend at the rate of 6½ per cent., and have reduced the price of gas by 5d. per 1000 cubic feet. Last year they also reduced the price by 5d.; and the Chairman, at the meeting on Wednesday, said that, notwithstanding the reduction, there had been a net profit of £324.

The revenue for the past year of the Greenock Water Trust amounted to £20,594; and the expenditure, to £20,572, of which £11,992 was for interest, and £325 was extraordinary expenditure. There was a surplus of £21. The Trust have taken advantage of their statutory power to postpone the operation of the sinking fund from 25 to 60 years. The advantage of this was seen in the fact that last year they were able to reduce the water-rate by 3d. per pound. Of the revenue, there was an increase of £400 upon the sum derived from millowners, which shows an improving trade in the town. Had the sugar works been in full working order, there would have been other £1500 of revenue.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 29.

Sulphate of Ammonia.—The market has been quiet; and the value at the close is £9 15s. f.o.b. at the ports. The quantity offered by makers has been rather larger; but actual requirements are small, and that probably accounts in the main for the decline in value. Dealers continue to offer ahead at a premium of 5s. to 7s. 6d. per ton, according to position.

Nitrate of Soda is unchanged; spot value being from 8s. 3d. to 8s. 4½d. per cwt.

LONDON, *June* 29.

Tar Products.—A more hopeful feeling has sprung up in regard to carbolic and cresylic acids, although business has been done at 1s. 4d. for 60's, and 1s. for refined cresol. These are exceptionally low prices; and it is felt that bottom has been touched in them. There is still a good inquiry for pitch; but fuel makers declare they are unable to pay the prices asked by dealers. The actual value of pitch largely depends upon the port of shipment; and, where high prices have been mentioned as having been obtained, it has been due to exceptionally low freights and other facilities. Very little has been done in anthracene; but it is firm at Committee rates, although some small outside lots have changed hands at less prices. A little more is being done in oils, but at most wretched prices. Transactions during the week have been marked at the following prices: Tar, 17s. to 21s. Pitch, 35s. to 37s. 6d. Benzols, 90's, 1s.; 50's, 11½d. Solvent naphtha, 1s. 0½d. Toluol, 1s. 0½d. Crude, 30 per cent. naphtha, 4½d. Creosote, liquid, 1½d.; ordinary, ¾d.; salts, 18s. Cresylic acid, refined, 1s.; brown, 10½d. Carbolic acid, 60's, 1s. 4½d. Anthracene, nominal, "A," 1s. 1d.; "B," 10d.

Sulphate of Ammonia continues weak. Buyers hold off for still lower prices. Stocks are comparatively low; and there is no reason why sulphate should be sold under £10, especially having regard to its nitrogen value relative to nitrate of soda. Prices realized during the week, at all ports, have ranged between £9 15s. and £9 17s. 6d., less 3½ per cent., according to port of shipment. Gas liquor is quoted at 7s. to 8s.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—Business throughout the coal trade of this district continues to drag on in a very slow fashion, as regards all descriptions of round coal, either for house-fire or iron-making, steam, and general manufacturing purposes; with three days per week still about the full average that the pits are working. So far as list rates are concerned, these remain nominally without any material alteration; but in the open market, there are plenty of sellers at very low figures, where clearances can be effected of surplus supplies—a good deal of coal being held under load, both in this and other surrounding colliery districts. In gas coal, the position remains very much as reported recently; and where contracts have been settled, they are practically upon the basis of prices that have previously been given. At the pit mouth, best Wigan Arley coals, although quoted at 10s. 6d., are only realizing this figure on occasional very small sales; 10s. per ton representing more nearly about the average selling price. Seconds Arley and Pemberton four-feet average about 8s. 6d. per ton; and common round coals, from 6s. for steam and forge qualities, to 7s. for house-fire descriptions. For gas coals, the average contract prices range from about 6s. 6d. per ton for good Wigan four-feet, to 7s. for partially-screened Arley mine coal. For shipment, excessively low prices have been quoted where sales of any weight can be made for prompt delivery; and 5s. 6d. per ton at the pit is a very common price. Delivered at the ports on the Mersey, there are sellers at about 7s. 3d. and 7s. 6d. per ton; while 7s. 9d. represents about the full average figure. Engine fuel moves off rapidly, owing to the present very restricted production of slack; but it can be scarcely reported as more than firm at recent quoted rates, any appreciable advance being very difficult to obtain.

Northern Coal Trade.—There has been a rather better demand for steam coals in the last few days; and with a production that has been diminished by the local race holidays, the market has been slightly quickened, though the range of prices is very little altered. The demand for household coal is naturally at about its lowest point; so that the collieries producing this class of coals are working very short time, and the same remark applies to other kinds of coal that have more especially a winter trade. Best Northumbrian steam coals may be quoted at about 8s. 9d. per ton f.o.b.; second kinds, at 8s. to 8s. 6d.; and steam smalls, at 3s. 3d. to 3s. 6d. The demand is slightly enlarged for the latter class. In gas coals, the demand is a little fuller, and must now be increased weekly, though it will be a month or two before it reaches its normal extent. Generally, the prices quoted range from 6s. to 7s. per ton f.o.b.; but contracts are taken at about the lowest of these prices, at about which figure some large dealings have taken place for delivery over the next twelve months. In the manufacturing coal trade, the demand has been locally quieter; but there has been a better export, especially of smithy coals. In the coke trade, the demand is a little larger, both for export and for use in the north-western furnaces; and the prices are fully maintained at 13s. to 14s. per ton f.o.b. Gas coke is only in limited production just now; and hence the stocks are small. Prices are unaltered. It is not expected that the decision of the Northumbrian miners to terminate the Conciliation Board at the end of the year, will lead to any labour difficulty. The Durham miners retain their Board.

Scotch Coal Trade.—There is no further fall in prices for coal in Scotland; and although there is great dulness, there is a belief arising that the lowest ebb has been passed, and that both demand and prices will now begin to improve. There are already indications that contracts which were lost last year on account of the strike, are again returning to Scotland. Meantime, a fair business is being done for home consumption; and iron and other trades are doing a large and profitable business. The prices quoted are: Main, 5s. 9d. per ton f.o.b. Glasgow; ell, 6s. 9d. to 7s. (full); splint, 6s. 3d. to 6s. 6d.; and steam, 7s. 6d. to 7s. 9d. The shipments for the week amounted to 144,993 tons—a decrease of 31,212 tons upon the previous week, and of 8329 tons upon the corresponding period of last year. For the year to date, the total shipments have been 3,120,558 tons—a decrease, as compared with the corresponding period of last year, of 394,487 tons.

The Brighouse Gas and Water Works.—At the meeting of the Brighouse Town Council last Wednesday, Alderman Sugden, the Chairman of the Gas Committee, presented the accounts of the department for the past year, showing a profit of £700. The gas-works, he stated, had been valued at £80,000, all of which had come out of the profits; the works really not having cost the ratepayers a penny. Alderman Stocks presented the annual statement as to the water-works, showing a loss of £300 for the year.

Maryport District Council Gas Supply.—The Maryport District Council having applied to the Local Government Board for sanction to borrow £1100 for gas purposes, Mr. Langton Coke, M.Inst.C.E., held an inquiry into the matter last Wednesday. The money, it appears, is required for extending the mains, and erecting lamps for lighting Ellenborough and Netherton, the cost of which is estimated by the Gas Manager (Mr. Morris) at the amount asked for. The extension now proposed to be carried out is part of the work contemplated when the Provisional Order of 1886 was obtained, giving the then Trustees powers to borrow £10,000 from time to time, subject to the approval of the Local Government Board.

The Oil-Gas Experiments in Bradford.—At a meeting of the Gas and Electricity Committee of the Bradford Town Council last Wednesday, it was stated that an endeavour had been made to get a further supply of oil for the oil-gas experiments at the Thornton Road gas-works, in order that Mr. Lewis T. Wright might make a trial of the process. The firm, however, who alone supply the oil, stated that they were unable to furnish a further quantity to the Corporation at the present time. In the discussion which followed, it was pointed out that the Corporation would be placed in a difficulty if the supply failed when the system had been adopted. As the Committee have still about 2½ tons of oil in stock, it was decided to communicate with Mr. Wright and Dr. Dvorkovitz, with the object of ascertaining whether this quantity is sufficient to allow the experiments to proceed.

The Glasgow Gas Commissioners' Contracts.—The Glasgow Corporation Gas Trust's Sub-Committee on Contracts have bought their supply of white Irish limestone for the next twelve months at 6s. and 6s. 10d. per ton. It is expected that something like 30,000 tons will be required. The suppliers' quarries are at Glenarm, on the Antrim coast, and their own steamers bring the limestone to the Clyde, where it is put on railway waggons to be conveyed direct into the various gas-works belonging to the Corporation. The same Sub-Committee have accepted an offer from Messrs. C. and W. Walker, to supply and erect a couple of their patent purifiers at the Dalmarnock Gas-Works. The Barrowfield Iron-Works Company, Limited, of Glasgow, have contracted with the Gas Commissioners to supply and erect four coke-riddling machines at the Dawsholm Gas-Works; and an offer has been accepted from the Airdrie Iron Company for the supply and erection of two large coke-hoppers at the same works.

East Surrey Water Company.—In the JOURNAL for the 18th ult., we briefly noticed the report of the Directors of this Company for the year ending March 25 last, which was presented at the meeting of shareholders on the previous Saturday. In moving its adoption, Sir F. Bramwell, F.R.S., called attention to the fact that, though the receipts appeared to be only £470 more than last year, as a matter of fact those from regular customers were £700 in excess. The previous year was, he said, one of abnormal drought; and there was in consequence a large sale of water for building and other purposes, which, to a certain extent, must be regarded as a kind of casual income. During the past year there had been less expenditure of this kind, which reduced the real increase of £700 from regular customers to the £470 appearing in the accounts. The policy of the Company during the eighteen years he had been associated with it was, first of all, to do their duty to the district by supplying, day and night, water which he believed to be of the first quality in the kingdom. This year the Company had obtained, for the first time, a dividend of 5 per cent. upon the ordinary shares; and there was every reason to believe it would be maintained. In conclusion, he referred with regret to the resignation as Chairman and Director of Mr. Easton, who had served the Company so ably and so long; and he cordially welcomed their new colleague, Sir Myles Fenton, who had accepted the vacant directorship, and also the post of Deputy-Chairman of the Company. The dividend recommended was declared. Votes of thanks having been accorded to the Chairman and Directors, Sir F. Bramwell, in responding, bore testimony to the valuable counsel and ready co-operation of his colleagues on the Board, and to the indefatigable exertions of the esteemed Manager and Secretary (Mr. J. R. Downes).

The Working of the Cleckheaton Gas Department.—The annual report of the Gas Department of the Cleckheaton District Council shows the gross profits on the year's operations to have been £3611, as compared with £2760 in the previous year. The capital employed is £38,410, which is equal to 11s. 3·93d. per 1000 cubic feet accounted for. The price of gas to consumers was 3s. per 1000 cubic feet, less 10 per cent. discount.

Increased Storage at the Willenhall Gas-Works.—A new tank and 100 feet telescopic gasholder are in course of construction for the Willenhall Gas Company, in accordance with the plans and specifications of Mr. W. North, of Stourbridge. Mr. T. Vale, of Stourport, is the Contractor for the tank; and Mr. Jesse Tildesley, of Willenhall, for the holder. The work is being carried out under the superintendence of Mr. J. C. Belton, the Company's General Manager.

Exhibitions of Gas Appliances.—A seven days' exhibition was concluded at Bolton last Friday. The appliances on view were principally the manufactures of Messrs. C. Wilson and Sons and Messrs. G. Bray and Co., of Leeds. At intervals during the exhibition, Miss Holroyd delivered some practical lectures on high-class, invalid, and every-day cookery. Gas and local trades exhibitions, prompted by Messrs. Richmond and Co., Limited, have just closed at Manchester, Edinburgh, Carmarthen, and Pontypridd; and in each case they have been marked with distinct success. At Manchester, there was a fine display of incandescent lights, sewing machines were driven by the "Stockport" gas-engine, and there were exhibits by various other firms in the gas industry. The exhibition was opened by Mr. C. Nickson, the Superintendent of the Corporation Gas Department; and lectures were delivered by Mrs. Brightwell. At Edinburgh, the lectures were by Miss S. L. Richmond, who was introduced to the audience by Bailie Kinloch Anderson, J.P. At Carmarthen the lectures by Miss Wilkinson were well attended, and she was presented with a purse of money by the audience. At Manchester, Edinburgh, and Pontypridd, the exhibitions had a fortnight's run; and a humourous lantern lecture, entitled "Gas *v.* Coal," was given at each place by Mr. E. W. T. Richmond. Messrs. Parkinson and Co. held a successful exhibition last week in the Victoria Rooms, Oswestry. Miss E. Sanderson gave practical demonstrations on cookery twice daily. Messrs. Fletcher, Russell, and Co., Limited, held an exhibition of their gas stoves and heaters in the Town Hall, Castle-Douglas, last week, at which Mrs. H. M. Young was the lecturer.

Tipton Gas Supply.—At the last meeting of the Tipton Urban District Council, the annual accounts of the Gas Department were presented. They showed that the gross profit was £4513; and the net profit, after payment of the principal and interest on loans, £3 15s. 6d. This sum, added to the balance of accumulated profits brought forward (£638 2s. 3d.), made a total of £641 17s. 9d., of which £100 had been employed for the installation of regenerative furnaces, and £167 for a bridge; leaving £374 17s. 9d. In a note at the end of the accounts, it is explained that, in compliance with the provisions of the Local Government Act of 1894, they are made up to the 31st instead of the 25th of March. The expenditure for this additional week was about £300; and, but for the alteration of date, the profits would have been increased by this amount. The gross profit represents a dividend at the rate of 6·1 per cent. upon the amount of capital employed. The statements relating to the working, which is under the supervision of Mr. Vincent Hughes, show that 8157 tons of coal and cannel were carbonized in the period covered by the accounts, as compared with 8432 tons in the preceding year; the quantity of gas made being 86,220,000 cubic feet, as against 90,422,000 cubic feet. The gas sold and used on the works amounted to 77,706,987 cubic feet, and the leakage, &c., to 8,402,416 cubic feet, or 9·75 per cent.; while for the year 1893-4, the figures were 81,786,332 cubic feet and 8,768,917 cubic feet, or 9·68 per cent. It is explained, however, that the quantity of gas sent out during the extra week was upwards of 1¼ million cubic feet, which is included in the gas not accounted for. Mr. Hughes points out that this ought to be deducted; and then the proportion of leakage, &c., would be reduced to 8 per cent. With regard to residuals, the make of coke and breeze is estimated at 4978 tons; of tar, 110,652 gallons; of ammoniacal liquor, 242,461 gallons of 10-oz. strength. The accounts were approved.

Cooking by Gas at Truro.—The Truro Gas Company have lately been having an exhibition of Messrs. J. Wright and Co.'s gas cooking-stoves; and, in conjunction therewith, Mrs. Thwaites gave an excellent series of lectures on cookery. This lady, in addition, prepared a gas-cooked dinner, which was served in the Public Rooms, and partaken of by the Mayor (Mr. Silvanus Trevail) and a party of gentlemen, including representatives of the Gas Company and Mr. S. J. Ingram, the Manager. After dinner, the Mayor proposed "Success to the Truro Gas Company;" remarking that the fact that so honourable and esteemed a citizen as their venerable friend Mr. Robert Tweedy was Chairman of the Company, entitled it to the highest respect. As to the use of gas for cooking, he believed the convenience of it at the Atlantic Hotel had been such that they would not do without gas-stoves under any consideration. Mr. Heard acknowledged the toast. He said it was the Company's endeavour to extend the usefulness of gas, more particularly for cooking; and he believed it would be much more generally used for this purpose in the future. Mr. J. James also responded, stating that the Company were desirous to give the community full value for the money they laid out. Their new Manager had, he said, given the greatest satisfaction; and the citizens generally would appreciate his services, if the future was to be at all representative of what he had done during the short time he had been with the Company. He was one who would hold up his hand for progress at any time. Mr. Ingram expressed his pleasure at witnessing the cordial relations existing between the Corporation and the Company. He said he thought they would find cooking by gas very economical, if properly managed; and the domestic who was not economical with a gas-stove, would be no more economical in the use of coal. He could assure the consumers, though they often looked with suspicion upon any recommendation from the manager of a gas-works, it was the Company's desire to treat their customers with the greatest possible consideration. Votes of thanks were accorded to Mrs. Thwaites and to Messrs. Wright and Co., and acknowledged by Mr. Pitts.

Messrs. Fletcher, Russell, and Co., Limited, finding the building reconstructed specially for them a few years ago at No. 115, Cheapside, much too small for the adequate display of a complete series of the Company's appliances, have taken larger premises at No. 134, Queen Victoria Street, which are expected to be ready for occupation next month.

The Sheffield Gas Company's Coal Contracts.—The Sheffield Gas Company, who require from 160,000 to 170,000 tons of coal, have just completed their contracts with local collieries. We learn that a good deal of satisfaction is expressed at the way in which Sir F. T. Mappin, Bart., M.P., the Chairman of the Company, and Mr. Hanbury Thomas, the General Manager, have conducted the business. They did not attempt to take advantage of the weakness of the market to cut down prices, but had the tenders delivered, and dealt with them in a very reasonable and satisfactory manner. As a general rule, the gas coal contracts which have been placed in the Yorkshire district were concluded at prices ranging from 3d. to 6d. per ton less than before.

Sales of Shares, &c.—Yesterday week, Messrs. Cox and Son sold at Torquay 300 £10 shares in the *Torquay Gas Company*, at prices ranging from £16 to £16 9s. The average price was £16 5s.; and the total realized was £4875 15s. A small number of £10 shares in the *Portsmouth Water Company* were sold locally a few days since at £28 15s. each. Messrs. William Bush and Son sold, last Tuesday, at Sheffield, six *Sheffield Corporation Water Annuities* of £5 each for £149 each. Seven annuities on the gradual scale at present at £2 15s. each, were sold for £112 10s., and one annuity on the graduated scale of £3 8s. 9d. was sold for 112½ per cent. Messrs. W. G. Stansfield and Co. disposed of some small amounts of gas stock at Bradford last Thursday, at the following figures: £20 of consolidated and £20 of original stock of the *South Shields Gas Company* for £75 each lot; and in the *North Bierley Gas Company* £30 of original stock for £61, £13 of new 7 per cent. stock for £17 10s., and £14 of new 7 per cent. stock (£2 16s. paid) for £5 2s. 6d., and £107 of capital stock for £212, and £25 of new stock for £36 10s. At Scarborough, last Wednesday, Messrs. W. T. Hart and Son sold £72 of 5 per cent. preference stock of the *Scarborough Gas Company* at £137 per cent.; and £105 of 7½ per cent. new consolidated stock at £175 per cent. These prices are the highest on record.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 28.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.				£ s. d.
590,000	10	10 Apl.	10½	Alliance & Dublin 10 p. c.	10	22 - 23	..	4 11 4
100,000	10	,,	7½	Do. 7 p. c.	10	15—16	..	4 13 1
300,000	100	2 Jan.	5	Australian (Sydney) 5 % Deb.	100	105—107	..	4 13 4
200,000	5	10 May	6½	Bombay, Limited	5	6¼—7¼	..	4 9 8
40,000	5	,,	6½	Do. New	4	5—5¼	+¼	4 14 7
380,000	Stck.	28 Feb.	11½	Brentford Consolidated	100	250—255	+3	4 10 2
180,000	,,	,,	8½	Do. New	100	200—205	+3	4 2 11
220,000	Stck.	14 Mar.	11	Brighton & Hove Original	100	220—225	..	4 17 9
888,500	Stck.	28 Feb.	5	Bristol	100	122—125	..	4 0 0
320,000	20	28 Mar.	11¼	British	20	52¼—53½	..	4 4 1
50,000	10	14 Mar.	11¼	Bromley, Ordinary 10 p. c.	10	22—23	..	5 0 0
51,510	10	,,	8½	Do. 7 p. c.	10	17—18	..	4 14 5
328,750	10	12 June	4	Buenos Ayres (New) Limited	10	7¼—7¾	..	5 3 2
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	100	100—103	..	5 16 7
150,000	20	28 Feb.	8½	Cagliari, Limited	20	26½—27½	..	6 0 0
550,000	Stck.	10 Apl.	13½	Commercial, Oil Stock	100	290—295	..	4 11 6
165,000	,,	,,	10½	Do. New do.	100	217—222	..	4 14 7
160,762	,,	12 June	4½	Do. 4½ p. c. Deb. do.	100	137—142	..	3 3 4
800,000	Stck.	12 June	13	Continental Union, Limited.	100	255—260	+5	5 0 0
200,000	,,	,,	10	Do. 7 p. c. Pref.	100	203—208	..	4 16 2
535,000	Stck.	28 Feb.	5¼	Crystal Palace Ord. 5 p. c. Stk	100	122—127	..	4 2 8
486,090	10	31 Jan.	11	European, Limited	10	24½—25½	..	4 6 3
354,060	10	,,	11	Do. Partly paid	7½	17—18	..	4 11 9
5,646,590	Stck.	14 Feb.	12	Gaslight & Coke, A, Ordinary	100	285—290	+10	4 2 8
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	105—110	..	3 12 9
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	277—282	..	3 10 10
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	130—135	..	3 14 1
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	197—202	..	3 14 3
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	188—193	..	3 12 6
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	277—282	..	3 10 10
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	100	165—170	..	3 10 7
1,061,150	,,	12 June	4	Do. 4 p. c. Deb. Stk.	100	128—131	..	3 1 0
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	140—145	..	3 2 1
908,000	,,	,,	6	Do. 6 p. c. do.	100	187—190	..	3 3 2
3,800,000	Stck.	10 May	12	Imperial Continental	100	247—252	..	4 15 3
75,000	5	26 June	6	Malta & Mediterranean, Ltd.	5	5½—6⅜	..	5 0 0
560,000	100	1 Apl.	5	Met. of Melbourne, 5 p.c. Deb.	100	114—116	+1	4 6 2
541,920	20	12 June	5	Monte Video, Limited	20	15½—16½	..	6 1 2
150,000	5	24 May	8	Oriental, Limited	5	7—7½	..	5 6 8
60,000	5	28 Mar.	7	Ottoman, Limited	5	4⅞—5¼	..	6 13 4
166,870	10	14 Feb.	2	Para, Limited	10	1½—2½	..	3 0 0
420,000	100	2 May	6	People's Gas of Chicago—1st Mtg. Bds.	100	102—106	..	5 13 2
500,000	100	4 June	6	2nd Do.	100	100—105	..	5 14 3
150,000	10	26 Apl.	7	San Paulo, Limited	10	8½—9½	..	7 7 4
500,000	Stck.	14 Feb.	15½	South Metropolitan, A Stock	100	355—365	..	4 4 11
1,350,000	,,	,,	12	Do. B do.	100	297—302	..	3 19 6
290,000	,,	,,	13	Do. C do.	100	307—312	..	4 3 4
775,000	,,	16 Jan.	5	Do. 5 p. c. Deb. Stk.	100	168—173	..	2 17 10
60,000	Stck.	28 Feb.	11½	Tottenham & Edm'nton, "A"	100	230—235	..	4 17 10
				WATER COMPANIES.				
746,021	Stck.	26 June	10	Chelsea, Ordinary	100	285-290*	+2½	3 9 0
1,719,514	Stck.	10 Apl.	8	East London, Ordinary	100	235—240	+5½	3 6 8
654,740	,,	26 June	4½	Do. 4½ p. c. Deb. Stk.	100	150—155*	+1½	2 18 0
700,000	50	26 June	7	Grand Junction	50	113-117*	+3½	2 19 10
708,000	Stck.	14 Feb.	12	Kent	100	307—312	..	3 16 11
1,043,800	100	26 June	7½	Lambeth, 10 p. c. max.	100	250-260*	+3½	2 17 8
406,200	100	,,	7½	Do. 7½ p. c. max.	100	205-210*	+6½	3 11 5
330,000	Stck.	28 Mar.	4	Do. 4 p. c. Deb. Stk.	100	140—145	..	2 15 11
500,000	100	14 Feb.	12½	New River, New Shares	100	370—380	+10	3 7 0
1,000,000	Stck.	31 Jan.	4	Do. 4 p. c. Deb. Stk.	100	142—144	..	2 15 7
902,300	Stck.	12 June	4	S'thwk & V'xhall, 10 p.c. max.	100	157—163	..	2 9 1
126,500	100	,,	4	Do. D 7½ p.c. do.	100	135—140	..	2 17 2
1,155,066	Stck.	12 June	10	West Middlesex	100	285-290*	+5	3 9 0

*Ex div.

The Profits of the Stoke-on-Trent Town Council.—The Executive Gas Committee of the Stoke-on-Trent Corporation have agreed to make a remittance of £2000 to the Town Council on account of the current year's profits.

The Suggested Reduction of the Illuminating Power of Gas at Liverpool.—Last Wednesday, a conference between the Lighting Committee of the Liverpool City Council and Mr. Edward Lawrence, Mr. H. B. Gilmour, and other representatives of the Gas Company, took place at the Town Hall, to consider the proposal to lower the illuminating power of the gas, and thus ensure greater cheapness to the consumers. To carry these suggestions into practical effect, an application to Parliament on the part of the Gas Company would be necessary; and the parties to last Wednesday's conference discussed the question whether such a measure would be desirable. The deliberations lasted nearly an hour; but it is stated that no definite decision was arrived at.

Explosion of a Gas-Engine at Ipswich.—Last Wednesday, a startling explosion took place in Salthouse Street, Ipswich, on the premises of Mr. C. E. Thurman, which have recently been fitted up as a flour-mill. Mr. Thurman, assisted by four men, was starting a new gas-engine of 14-horse power, when suddenly the condenser exploded with a loud report, blowing away the brick and iron work surrounding it, and doing other damage. Happily, not one of the men near the engine was injured, though the force of the explosion smashed the windows and blew off a portion of the roof of the building. It is supposed that some foul air in the condenser which burst was the cause of the explosion, and with the exception of a few pipes and rods twisted, no material damage was done.

Selby Gas Supply.—The report of the Manager of the Selby Gas Department (Mr. M. Dunn) for the month ending the 25th ult., shows an increase to the extent of 37·75 per cent. in the production, and of 34·33 per cent. in the consumption of gas, as compared with the corresponding period of 1894. The price has been reduced from 3s. 3d. to 3s. per 1000 cubic feet to ordinary consumers; and those using prepayment meters now receive 25 instead of 20 cubic feet of gas for 1d. A fresh district of supply has been added; and the mains to connect it with the present area are being laid. The necessary additions and alterations to the plant to meet the extra demand for gas are also being proceeded with. It is gratifying to learn that Mr. Dunn is able to dispense with Sunday labour in his works during the summer months.

Water Supply for Yorkshire Villages.—The Malton Rural District Council had before them last Saturday week the question of the water supply to a number of villages in their district—including Slingsby, Brawby, and Butterwick—which is being pressed on their attention by the Local Government Board. A report was read by Mr. Richardson, engineer, in which he suggested a joint scheme for supplying several villages. A Committee is considering the matter.

Seville Water-Works Company, Limited.—The annual meeting of this Company was held last Thursday, at the London Offices, No. 86, Cannon Street. The report and accounts for the year ending March 31 last showed that the income was £29,432; and on taking into account the credit on exchange, it was £30,148. After deducting working expenses, the cost of laying on services, and debenture interest, the net profit was £11,808, as compared with £9323 in the previous year. Adding the unappropriated profit at March 31, 1894—£1118—and charging the contribution to the sinking fund of £610, the interim dividend, and placing £2000 to the reserve fund, made the amount standing to the credit of profit and loss account £6249. The Directors recommended that a dividend at the rate of 4 per cent. per annum, free of income-tax, be paid for the past half year, which would absorb £5422, and leave £827 to be carried forward. The Directors announced the death of their colleague Mr. Edward Horner, and the appointment of Mr. Easton Devonshire to fill the vacancy. The Chairman (Mr. David Evans), in moving the adoption of the accounts and the declaration of the dividend, mentioned that exchange had improved since the last meeting; but it was a little higher now than it was on March 31 last. The tendency again appeared to be to go down; and therefore, he hoped, they would have a lower average rate of exchange for this year's remittances than last. The Directors had had formal application from Messrs. Easton, Anderson, and Goolden (who had become a limited Company) to be released of their liability to complete the contract, as the limited Company were disinclined to be subject to an indefinite liability. They claimed either to complete their contract, or to be relieved of their liability to complete it. The Company's arrangements with the Municipality did not admit of immediate completion; and the opinion of their legal advisers was that this was a matter for compromise. Mr. W. Blaber seconded the motion; and after a short discussion, in which Count Torri Diaz and Mr. E. A. Hankey took part, the motion was carried. The retiring Directors (Messrs. Evans and Blaber) and Auditors were re-elected.

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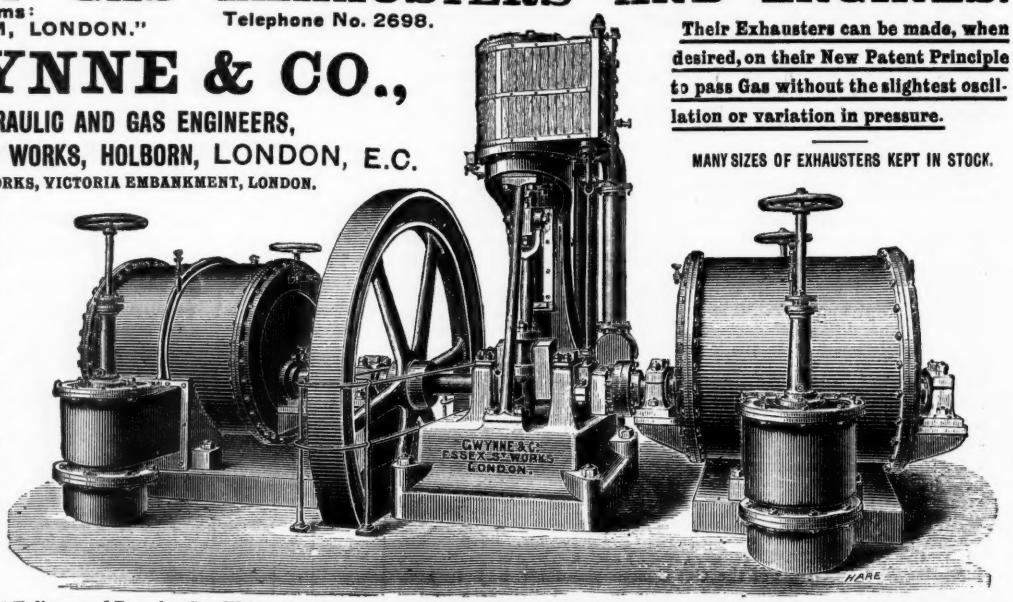

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*** See Advertisement p. II., centre of JOURNAL.

Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

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Telegraphic Address: "PORTER LINCOLN."

NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS, should be received not later than the FIRST POST on SATURDAY.

AMMONIACAL LIQUOR Wanted.
BROTHERTON AND Co., Ammonia Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

GAS TAR Wanted.
BROTHERTON AND Co., Tar Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SPENT OXIDE Wanted.
BROTHERTON AND Co., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

BROTHERTON & CO.
Offices: Commercial Buildings, LEEDS. Correspondence invited.

GOLD MEDAL, 1892.
TUBES and Fittings for Gas, Steam, and Water, in stock to 8 inches diameter; Iron and Steel Ascension-Pipes.
JOHN SPENCER, Globe Tube Works, WEDNESBURY; and 14, Great St. Thomas Apostle, LONDON.

CHARTERING, FORWARDING, AND INSURANCE.
ROBERT BRUCE FITZMAURICE, 29, Great St. Helens, London, Shipping Agent to several Gas Companies and Plant Manufacturers, would be glad to UNDERTAKE LARGE or SMALL SHIPMENTS to any Port.

WANTED, a Situation as Blacksmith, MAIN and SERVICE LAYER, &c. Good References.
Address GEO. F. SMITH, Gas-Works, Romford, ESSEX.

BELGIAN Gentleman, age 35 (cannot speak English fluently), seeks a Situation as ASSISTANT in Laboratory. Good Analytical Chemist. Diploma.
Address Jos. THEYS, 39, Berwick Street, Eccleston Square, LONDON, S.W.

ADVERTISER desires Engagement as ASSISTANT to Engineer or Manager of Gas or Water Works. Eight years' experience. Drawing, Quantities, and Specifications, in addition to ordinary routine.
Address No. 2534, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

ADVERTISER, with 25 Years' Ex- perience as Working Manager and Foreman, desires a Situation as WORKING FOREMAN. Practically acquainted with every detail of work in the Construction and Maintenance of Gas-Works, and the Manufacture and Distribution of Gas on modern principles. Good Testimonials.
Please address No. 2539, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO GAS-FITTERS.
WANTED, a steady and experienced per- son as GAS and WATER FITTER, with knowledge of Inside Fittings, able to read Meters, &c.
Apply, stating Age, Experience, and Wages required (not later than July 12), to JOHN DUXBURY, Manager, Windermere District Gas and Water Company.

YSTRAD GAS AND WATER COMPANY.
WANTED, two Water Inspectors, accustomed to Waste-Water Inspection. Able to do Plumbing and Gas-Fitting if required. Salary, 30s. per week, with uniform.
Applications, stating age, &c., accompanied with *copies* of testimonials, to be sent to the undersigned on or before the 12th inst.
ALBERT R. CAWLEY, General Manager.
Pentre, R.S.O., Glam.

FOR SALE—
RETORTS, 190 feet, Oval and Round.
MOUTHPIECES for do., 182.
ASCENSION-PIPES, 168, taper 6 inches to 5 inches, ⅜-inch Metal.
BRIDGE-PIPES, 168, 5 inches by 20 inches wide, with Covers.
Cast-Iron DIP-PIPES, 168, 5 inches diameter, with Flanges.
HYDRAULIC MAIN, 288 feet, 15 inches deep, 18 inches wide.
SECONDARY MAIN, 258 feet of 10-inch.
Patent TAR-RECEIVERS, 18, 9 feet long by 12 inches diameter, flanged.
SCRUBBER TOWERS, 2, 35 ft. by 4 ft. 6 in.—one fitted with Cast-Iron Caps; the other, with Coke.
DONKIN VALVES, 10, 6-inch; 8, 8-inch; 18, 12-inch.
Pair of PURIFIERS, 20 ft. 6 in. by 21 ft. 6 in. by 5 ft. 3 in., with Travelling Gear, all complete.
CONDENSER, consisting of 168 feet of 18-inch Pipe, ⅜ Metal Socket Joints, with Bends, and entering a Cast-Iron Box, 14 ft. 6 in. by 2 ft. by 2 ft. 6 in.
LIVESEY WASHERS, 2, with Piping and Valves complete.
Two LAYCOCK and CLAPHAM WASHERS, with Horizontal Shaft, Fittings, and Valves, all complete.
One DONKIN EXHAUSTER, H.O.M. per hour, with Valves.
Two GAS-GOVERNORS; GAS-BOXES.
Flanged CAST-IRON PIPES, 6, 8, and 12 inch.
SOCKETED MAIN, 8-inch and 12-inch.
BUCK-STAVES, and a quantity of METAL and WROUGHT IRON.
Apply, in first instance, to JOSIAH HARDMAN, Manufacturer, Milton, STAFFS.

SPECIAL PAINT FOR GAS-WORKS.
JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS, MANCHESTER.
Telegrams: "ENAMEL." National Telephone 1759.

GAS PLANT CEMENT.
JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS, MANCHESTER.
For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

AMMONIA SATURATORS.
WALTER THOMASON and SONS, Chemical Plumbers, &c., and Makers of Lead Saturators, &c., 21, WESTON STREET, BOLTON. Repairs of every description.
Please write for Estimate before ordering elsewhere.

PATENTS FOR INVENTIONS.
J. C. CHAPMAN, M.I.M.E. and Fel. Chartered Inst. Patent Agents. ADVICE ON ALL MATTERS CONNECTED WITH ABOVE.
Information and Handbook on application.
70, CHANCERY LANE, LONDON, W.C.

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 315, St. Vincent Street, GLASGOW; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.
Head Office MIDDLESBROUGH. Correspondence invited.

BOROUGH OF NELSON.
(GAS DEPARTMENT.)

THE Gas Committee of the above Cor- poration invite TENDERS for the supply of about 60 Tons of NATURAL BOG ORE, delivered free at Nelson Station.
Form of Tender and further Particulars may be obtained from Mr. W. Foster, Gas Manager.
Sealed tenders, endorsed "Bog Ore," to be sent to me the undersigned, on or before the 10th day of July, 1895.
By order,
R. M. PRESCOTT, Town Clerk.
Town Hall, Nelson, June 25, 1895.

BOROUGH OF NELSON.
(GAS DEPARTMENT.)

THE Gas Committee of the above Cor- poration invite TENDERS for the purchase of about 100 Tons of SPENT OXIDE, delivered into Contractor's Trucks, free on Rails at Nelson.
Samples and Form of Tender may be obtained from Mr. W. Foster, Gas Manager.
Sealed tenders, endorsed "Spent Oxide," to be sent to me the undersigned, on or before the 10th day of July, 1895.
By order,
R. M. PRESCOTT, Town Clerk.
Town Hall, Nelson, June 25, 1895.

OSWALDTWISTLE URBAN DISTRICT COUNCIL.

THE Gas Committee invite Tenders for the TAR and LIQUOR produced at their Works for One Year from the 31st day of July, 1895.
The quantity of Coal carbonized is about 3500 Tons.
Further Particulars may be obtained from the Manager, Gas-Works, Church, near Accrington.
Tenders, endorsed "Tender for Tar," to be addressed to me, and to be delivered not later than Wednesday, the 31st of July.
WM. SANDEMAN, Clerk.
District Council Offices, Oswaldtwistle, June 26, 1895.

URBAN DISTRICT OF MILFORD HAVEN.

TENDERS FOR GAS AND STEAM COAL.

THE Milford Haven Urban District Council are prepared to receive TENDERS for about 600 Tons of large through and small GAS COAL, and about 70 Tons of good BITUMINOUS STEAM COAL, to be delivered between the 1st of September, 1895, and the 1st of September, 1896. The whole of the Coal to be fresh hewn, clean, and free from Impurities.
Further Particulars and Forms of Tender can be obtained on application to the undersigned.
Sealed tenders, endorsed "Tender for Coal," addressed to the Chairman, Gas and Water Committee, to be sent in not later than the 16th of July next.
The Council do not bind themselves to accept the lowest or any tender.
By order,
THOMAS H. LEWIS, Clerk.
Milford Haven, June 28, 1895.

HYDRATED OXIDE OF IRON.

PREPARED from pure Iron.
Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.
READ HOLLIDAY AND SONS, LIMITED, HUDDERSFIELD.

HUTCHINSON BROTHERS, Gas Engineers, &c., Falcon Works, Barnsley, Makers of Wet and Dry Gas-Meters, Brass-Work, and general Gas Apparatus, Lead Saturators, Tanks, &c., Tools, and Gas-Works Sundries. (See last week, p. 1404.)
Telegrams: "HUTCHINSON BROS., BARNSLEY."

THE Undersigned is in a position to supply, at the very lowest Prices, the most suitable kind of BENZOL for enriching Gas, made from Hardman's Patent Carbonization Process, of which I am the Sole Patentee. On application, I would furnish Price on the most reasonable terms; giving advice how to utilize it on the most economical method.
J. HARDMAN, Manufacturing Chemist.
Milton, Staffs.

BACK-PRESSURE IN PURIFIERS.

THE Valve invented by Mr. Cripps for Bye-Passing any Layer of Purifying Material (referred to by the President of the Incorporated Institution of Gas Engineers in his Inaugural Address) can be obtained of the Makers: C. & W. WALKER, Midland Iron-Works, Donnington, near Newport, SALOP, and J. EVERY & SON, Phœnix Iron-Works, LEWES, to which Firms all inquiries should be addressed.

In Paper Covers, Post Free 2s.
STEPHEN CARPENTER, of the Bow Common Gas-Works, on the Purification of Coal Gas by Lime, Oxide of Iron, and Atmospheric Air, and the Method of Working Purifiers so that the Lime may be used a second time, with a description of Carpenter's short Method of working off the Sulphur Test and Table for calculating Results.
S. & H. W. CARPENTER, 3, Bedford Villas, Carshalton, SURREY.

BOROUGH OF HEYWOOD.

THE Gas Committee invite Tenders for surplus TAR. Estimated quantity, 600 Tons.
Further Particulars and Form of Tender may be obtained from Mr. Whatmough, Gas Manager.
Tenders, endorsed "Tar," to be sent to me not later than Tuesday, July 16, 1895.
By order,
A. B. PILLING, Town Clerk.
Municipal Buildings, Heywood, July 1, 1895.

BOROUGH OF HEYWOOD.

THE Gas Committee invite Tenders for the supply of SULPHURIC ACID and TUBES and FITTINGS.
Specification and Form of Tender may be obtained from Mr. Whatmough, Gas Manager.
Contractors tendering for this work must pay their workpeople at least the standard or trade union rate of wages, and observe the trade conditions which attach to the various kinds of work for which the tender is sent in.
Sealed and endorsed tenders to be sent to me not later than Tuesday, July 16, 1895.
By order,
A. B. PILLING, Town Clerk.
Municipal Buildings, Heywood, July 1, 1895.

NORTHWICH GAS COMPANY.

TENDERS are invited for the purchase of the surplus TAR produced at these Works during the ensuing Year.
Any further Particulars required may be had on application to Mr. S. S. Mellor, the Manager.
Tenders, endorsed "Tar," and addressed to the Chairman, must be delivered here not later than Nine a.m., on Saturday, July 6, 1895.
HENRY PICKERING, Secretary.
Gas Office, Northwich, June 25, 1895.

NORTHWICH GAS COMPANY.

TENDERS are invited for the supply and delivery at Northwich Railway Station, of about 3500 Tons of screened GAS COAL and 250 Tons of CANNEL during the Year ending June 30, 1896.
TENDERS are also invited for the supply and delivery of LIME and SULPHURIC ACID during the same period.
Any further Particulars required may be had on application to Mr. S. S. Mellor, the Manager.
Tenders, endorsed and addressed to the Chairman, must be delivered here not later than Nine a.m., on Saturday, July 6 next.
HENRY PICKERING, Secretary.
Gas Office, Northwich, June 25, 1895.

WREXHAM GASLIGHT COMPANY.

TO TAR DISTILLERS AND OTHERS.

THE Directors of the above Company invite TENDERS for the surplus TAR and AMMONIACAL LIQUOR produced at their Works for One Year commencing on the 1st day of August next. Quantity produced, about 450 and 550 Tons respectively.

Further Information may be obtained on application to the undersigned, to whom tenders must be sent not later than the 20th prox.

The Directors do not bind themselves to accept the highest or any tender.

By order of the Board,
THOS. WALKER,
Secretary and Manager.

Wrexham, June 28, 1895.

COAL AND CANNEL.

THE Gas Committee of the Carnarvon Corporation invite TENDERS for the supply of 1800 Tons (more or less) of good GAS COAL, and about 150 Tons (more or less) of CANNEL, delivered as required during the Year ending Aug. 31, 1896, free in Trucks at Carnarvon Railway Station, L. & N.W.R.

Form of Tender and any further Information may be obtained from the undersigned.

Sealed tenders, endorsed "Tender for Coal and Cannel," and addressed to the Chairman of the Gas Committee, Guildhall, Carnarvon, to be delivered not later than Saturday, July 13 next.

The Committee do not bind themselves to accept the lowest or any tender.

THOMAS WILKINSON,
Engineer and Manager.

Gas Office, Carnarvon,
June 29, 1895.

WALLINGFORD GASLIGHT AND COKE COMPANY, LIMITED

TENDERS FOR GAS COAL.

THE Wallingford Gaslight and Coke Company, Limited, invite TENDERS for the supply for One Year, from the 13th of August next, of about 900 Tons of best screened GAS COAL, to be delivered free, at the Railway Station at Wallingford, in such quantities and at such times as the Company may require.

Payments monthly.

Sealed tenders, endorsed "Tender for Gas Coal," to be delivered on or before the 31st of July next.

The Company do not bind themselves to accept the lowest or any tender.

By order,
JOHN CARTHEW,
Secretary.

Wallingford, June 24, 1895.

NOTICE.

TO GAS ENGINEERS AND OTHERS.

MESSRS. CLAPHAM BROS., Limited, Keighley, Yorkshire, are no longer authorized to Manufacture my CONDENSER and WASHER-SCRUBBERS.

The above-named Gas Apparatus are erected and giving entire satisfaction at the following places: Neath, Lincoln, Sheffield, Ellesmere, Mountain Ash, Malden, Cullingworth, Montreal (Canada), Woodstock (South Africa), Cape Town (South Africa), &c.

These Appliances can now be obtained solely of the undersigned.

Winchester House, London, E.C. J. A. KELMAN.

NOTICES FOR POSTING IN GAS-WORKS.

CARDS suitable for Exhibiting in Gas-Works, directing Officers and Workmen to REPORT all ACCIDENTS witnessed by them, together with the Clause of the "NOTICE OF ACCIDENTS ACT, 1894," specifying the notice required to be sent to the Board of Trade, can be obtained, *price 4d. each, or 2s. 6d. per dozen, post free.*

Section 4 of the "CONSPIRACY AND PROTECTION OF PROPERTY ACT, 1875," has been similarly printed. It is required, under a Penalty of FIVE POUNDS, that a Copy of the Section shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by persons employed thereat. Copies, in large type, on broad sheets (22½ inches by 17½ inches) may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C. *Price 2s. per dozen; 10s. 6d. per 100.* On Cards the same size as those relating to the "Notice of Accidents Act," *price 4d. each or 2s. 6d. per dozen.*

"BEAR CREEK" CANNEL.

LOG MOUNTAIN COAL, COKE, AND TIMBER CO.,
PINEVILLE, KENTUCKY, U.S.A.
Cable Address: "Hull, Pineville."

LONDON AGENTS:
W. J. WILSON & Co., Suffolk House, Cannon St., E.C.

TO EMPLOYERS, COMPANY DIRECTORS, ETC.

The LAW GUARANTEE & TRUST SOCIETY, LIMITED,
GUARANTEES FIDELITY.
Send for complete Prospectus, containing Balance-Sheet, Copy of Policy, &c., &c.

HEAD OFFICE:
49, CHANCERY LANE, LONDON, W.C.

NOTICE.

The Incandescent Gas-Light Company, Limited, Hereby Give Notice, that they only supply their Mantles subject to the following express Conditions, which are printed and pasted on each box:—

"The Incandescent Gas-Light Company, Limited, in supplying the Mantle contained in this box, grant a Limited License to the purchaser to sell or use the same on the express condition that neither the purchaser nor any other person into whose hands the same may come shall use or sell the said Mantle except in connection, or for use, with Burners sold or supplied by the Company; any other sale or use will amount to Infringement of the Company's Patents. The Company supply Mantles for the purpose of renewals at the nominal price of 1s. 3d., subject to the Conditions and Limitations above set forth."

In the case of *The Incandescent Gas-Light Company, Limited v. Cantelo*, Mr. Justice Wills upheld the Validity of these Conditions and Limited License; and, in the course of his Judgment, said:—

"The patentee has the sole right of using and selling the articles; and he may prevent anybody from dealing with them at all. Inasmuch as he has the right to prevent people from using them or dealing in them at all, he has the right to do the lesser thing—that is to say, to impose his own conditions. It does not matter how unreasonable or how absurd the conditions are. It does not matter what they are if he says at the time when the purchaser proposes to buy, or the person proposes to take a license: 'Mind I only give you this license on this condition;' and the purchaser is free to leave it or take it as he likes. If he takes it, he must be bound by the condition."

In the case of *The Incandescent Gas-Light Company v. Hirschfeld and Others*, the Honourable Mr. Justice Romer certified that the Validity of the Plaintiffs' Patents was established. Infringers in future will be liable to costs as between Solicitor and Client.

(Signed) **FAITHFULL & OWEN,**
Solicitors for the Incandescent Gas-Light Company, Limited.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.

Output about 3000 tons per day.

ANALYSIS—		
Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Bombay Gas Company, San Paulo Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the

HARTON COAL COMPANY, LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON,
FITTER.

HEATHCOTE GAS COAL.

Rich in Illuminating Power & Yield of Gas.
Above the average in Weight & Quality of Coke.
Maintains a High Standard in Residuals.

THE GRASSMOOR Co., LD.,
CHESTERFIELD.

AUTOMATIC COAL and COKE HANDLING.

We have erected, and are erecting, a number of the most complete

AUTOMATIC COAL AND COKE HANDLING PLANTS
In the World.

☛ We are now engaged erecting a plant to distribute the Coal into 375 Coke-Ovens, each 30 feet long, and convey the HOT Coke on an improved Conveyor to the Blast-Furnaces. We have also on order six Plants to elevate and convey from 200 to 2000 Tons of Coal per day. For the latter, we are supplying three Conveyors, each 72 inches wide, with Cast Steel Chain Elevators and Accessories to suit.

Address:—
NEW CONVEYOR COMPANY, LD.,
3 & 4, Lime Street Square, London, E.C.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS:—

Yield of Gas Per Ton . . 11,205 Cubic Feet.
Illuminating Power, 16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality) 13¾ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE, 2500 TONS.

RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton . . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . 13½ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar . . . . . 180 Lbs. (Avoir.) Per Ton
Ammoniacal Liquor 94½ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COALFIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

HEBBURN MAIN GAS COALS.

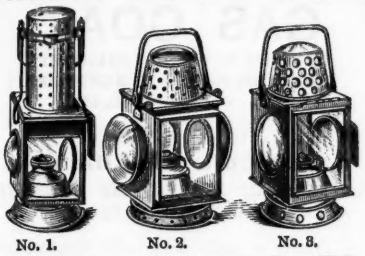
Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For prices, f.o.b. Ship or Delivered by Rail, apply to

THE WALLSEND & HEBBURN COAL COMPANY, LTD.
8 Lombard Street,
NEWCASTLE-ON-TYNE.

W. RICHARDSON, Fitter.

ARMSTRONG'S PATENT
CANDLE SAFETY LAMPS.



No. 1. No. 2. No. 3.

48, MANCHESTER STREET, GRAY'S INN ROAD, W.C.

PIPES, 2-in. to 8-in. PIPES, 2-in. to 8-in. PIPES.

MONIER-WILLIAMS & Co.

IRONFOUNDERS,

MIDDLESBROUGH.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

CANNEL & COAL.

TYNE
BOGHEAD CANNEL.

Yield of Gas per ton . . . . . 13,155 cub. ft.
Illuminating Power . . . . . 38·22 candles.
Coke per ton . . . . . 1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 73·1 per cent.

For Prices and complete Analysis, apply to

THOS. W. DANCE & SONS,
COAL OWNERS, NEWCASTLE-ON-TYNE;
OR
E. FOSTER & CO.,
21, JOHN STREET, ADELPHI, LONDON, W.C.

COKE-BREAKERS,

PRICES REDUCED.
(THOMAS & SOMERVILLE'S PATENT.)
New Design, with two Cutting Rollers, making less Breeze than their old pattern.

GEORGE WALLER & CO.,
PARK STREET, SOUTHWARK, E.C.,
And at STROUD, GLOUCESTERSHIRE.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,

LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

THOMAS TURTON AND SONS, LIMITED,

SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
LONDON OFFICE:
90, CANNON STREET, E.C.

TAR AND LIQUOR PURCHASED.

JOHN CLARKSON MAJOR,

(Established 1851,)
Tar Distiller and Manufacturing Chemist,
WOLVERHAMPTON.

THORNLEY GAS COALS

WORKED BY THE
WEARDALE IRON & COAL Co. Ld.
OUT OF THEIR
THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by
Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton . . 10,500 Cub. Ft.
Illuminating Power . . 16·9 Candles.
Coke (of good quality) . . 67·5 per Cent.
Sulphur . . . . . 0·58 „
Ash . . . . . 2·73 „

For Price, &c., apply to the
WEARDALE IRON & COAL Co., Ld.
QUAYSIDE, NEWCASTLE-ON-TYNE.

KENT'S THICK GAS COAL

RAISED AT
The Wharncliffe Woodmoor Colliery,
BARNSLEY.

Yield of Gas, nearly 12,000 *Cubic Feet per ton of Coal; and Illuminating Power nearly* 17½ *Candles.*

The following is a complete ANALYSIS made by Mr. R. O. PATERSON, C.E., Gas-Works, Cheltenham:—

Specific Gravity (Water 1). . 1·276
Weight of One Cubic Foot. . 79·700 lbs.

PROXIMATE ANALYSIS.

Moisture in Coal . . . . . 2·68 per cent.
Volatile Matter. . . . . 35·60 „
Fixed Carbon . . . . . 58·80 „
Sulphur . . . . . 0·96 „
Ash. . . . . 1·96 „

COMMERCIAL ANALYSIS.

Gas per Ton of Coal . . . . 11,760 cub. feet.
Gas per Cubic Foot of Coal . 418 „
Illuminating Power . . . . 17·44 candles.
Value of One Cubic Foot in Sperm . . . . . 418 grains.
Value per Ton of Coal in Sperm . . . . . 703 lbs.
Coke per Ton of Coal . . . 1367 „
Coke . . . . . 61·05 per cent.
Ash in Coke . . . . . 3·21 „
Sulphur Eliminated with Volatile Products per Ton of Coal 9·4 lbs.
Sulphur in Coke per Ton of Coal . . . . . 12 „
Ammoniacal Liquor per Ton of Coal . . . . . 19·7 galls.
Tar per Ton of Coal . . . . 12·2 „

R. O. PATERSON, C.E.
Gas-Works, Cheltenham,
8th August, 1894.

For Price, &c., apply to the
Wharncliffe Woodmoor Colliery Co LIMITED,
BARNSLEY;
Or to Mr. W. H. HARVEY,
17, Old Queen Street, Westminster, S.W.

HUNTER'S
OXIDE OF IRON.
JAMES HUNTER, MINER, AND SHIPPER OF
NATURAL IRISH BOG ORE.
This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.
Samples and Prices on application.
11, BAY STREET, PORT GLASGOW.
Telegrams: "HUNTER, PORT GLASGOW."
Established 1872.

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Gas Companies are solicited to try Samples of the
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MIRFIELD (GAS-COAL) COLLIERY COMPY.
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Illuminating Power . 45·6 Candles.
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FROM THE
MARQUIS OF LONDONDERRY'S COLLIERIES,
COUNTY OF DURHAM.
Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
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FIRE-CLAY & BRICK WORKS,
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Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

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ILLUMINATING POWER . 17·50 SPERM CANDLES.
COKE. . . . . 75 PER CENT.
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RAVENS LODGE AND CONYERS' COLLIERIES,
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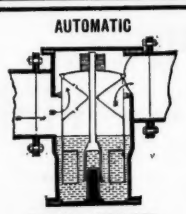
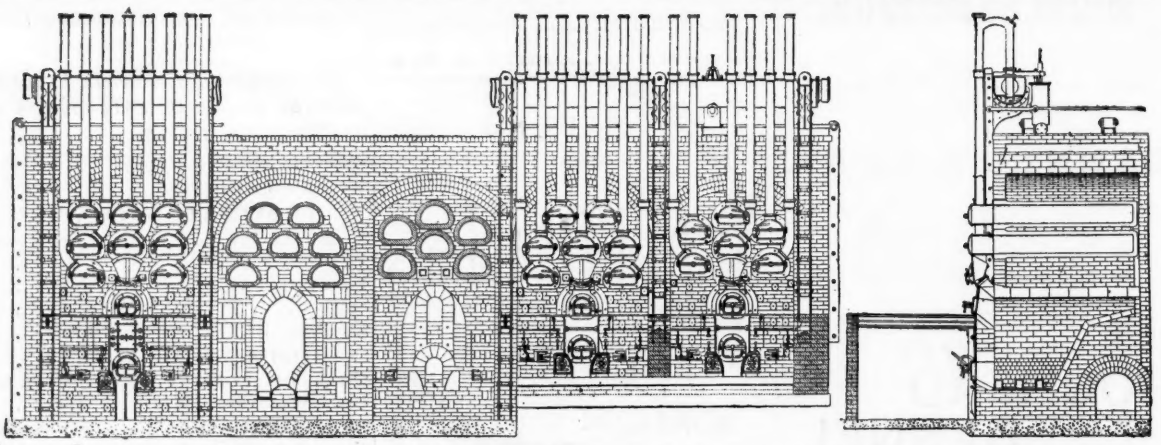
A TRIAL IS RESPECTFULLY SOLICITED.

JAMES MILNE & SON, LTD.,
ENGINEERS, BRASSFOUNDERS, & GAS APPARATUS MAKERS,
MILTON HOUSE WORKS, EDINBURGH.
ESTABLISHED EDINBURGH, 1750. LONDON, 1851. GLASGOW, 1887. LEEDS, 1893.



HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY, AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS CARBONIZING FROM 18 TO 24 CWT. OF ENGLISH AND 21 TO 26 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

Full Particulars may be had on application to the Patentee's Agents: **Messrs. JONAS DRAKE AND SON**, Retort Setters and General Carbonizing Engineers, Ovenden, Halifax, Yorkshire, Sole Agents for England, Wales, and Foreign Countries; **C. M. HAMILTON**, Retort Setter and Contractor, 5, Stuart Street, Shawlands, Glasgow, Agent for Scotland and Ireland; and to the Principal Agent, **R. F. HISLOP** (Son of Patentee), General Constructing and Carbonizing Engineer, Gas-Works, Paisley, N.B.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non* TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

The Patentee's SELF-SEALING CAPS FOR THE TOP OF ASCENSION-PIPES, and his "SPECIAL" FLUE PORT BOXES, are most important additions to his Carbonizing Plant.

SPENT LIMES NO LONGER WASTE PRODUCTS.
Under G. R. HISLOP'S Patents, all Spent Limes are effectively recovered at from one-third to one-half the cost of New Lime.
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Have during the past 2½ years constructed

CARBURETTED WATER-GAS PLANTS

Of the following daily capacities:—

Copenhagen	700,000 Cub. Ft.	Brussels	700,000 Cub. Ft.
Belfast	1,700,000 ,,	Liverpool	2,500,000 ,,
Glasgow	300,000 ,,	Tottenham	600,000 ,,
Santiago	400,000 ,,		

And have now under Contract:—

Belfast (Second Contract)	3,500,000 Cub. Ft.	Southport	750,000 Cub. Ft.
Brighton	1,250,000 ,,	Manchester	3,000,000 ,,
Swansea	700,000 ,,	Bath	1,000,000 ,,
Preston	1,500,000 ,,		

In addition to which the previous Installations of The Gaslight and Coke Company under this System have a total capacity of 10,000,000 cubic feet per diem.

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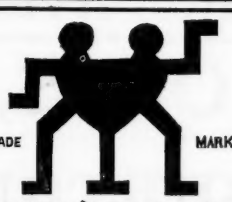

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A Month's free trial.

JOINTING CEMENT 1 cwt. equals 3 cwt. of RED LEAD.

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IMPROVED SYSTEM OF CARBURETTED WATER-GAS PLANT PARTICULARS ON APPLICATION.

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Analysis: 12,600 feet of 19-candle gas per ton.
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Made strong for Horizontal and Inclined Retorts in Round, Oval, and ⌂ shapes, and to open at Right Angles for Machine Work. Faced in Ruscoe's Patented Machines; thus ensuring correct and smooth joints when closed.

TESTIMONIALS.

Sheffield United Gaslight Company, Commercial Street, Sheffield, 11th April, 1895.

DEAR SIR,—In reply to your enquiry, I have pleasure in saying that we have a number of your Retort Mouthpieces at work, and that they give perfect satisfaction.

Yours faithfully,
FLETCHER W. STEVENSON,
Engineer.

Mr. JOHN RUSCOE.

Leigh Urban District Council, Gas & Water Departments, Leigh, Lancs., April 11th, 1895.

DEAR SIR,—In reply to yours of yesterday, I have pleasure in testifying that the Retort Mouthpieces which you supplied to the Leigh Gas-Works seven years ago have given every satisfaction. We have now 267 of the Mouthpieces erected, and hitherto none have required refacing.

Yours faithfully,
A. T. FLETCHER.

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FOR PARTICULARS APPLY TO **JOHN RUSCOE, ALBION WORKS, HYDE.**

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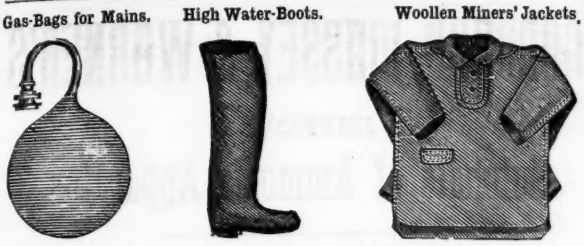

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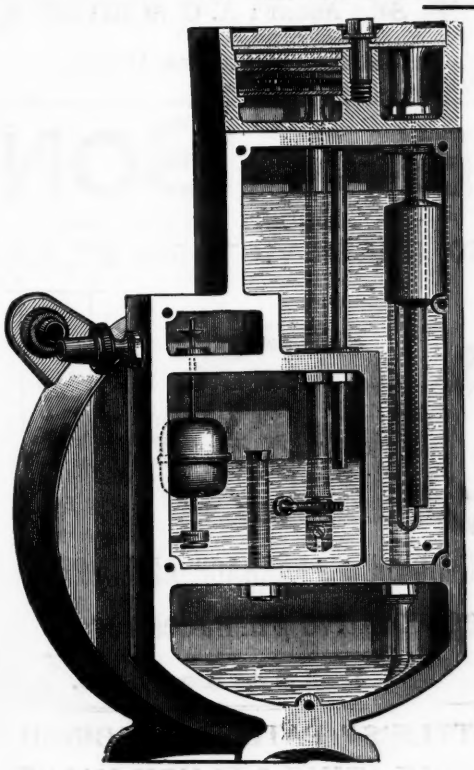

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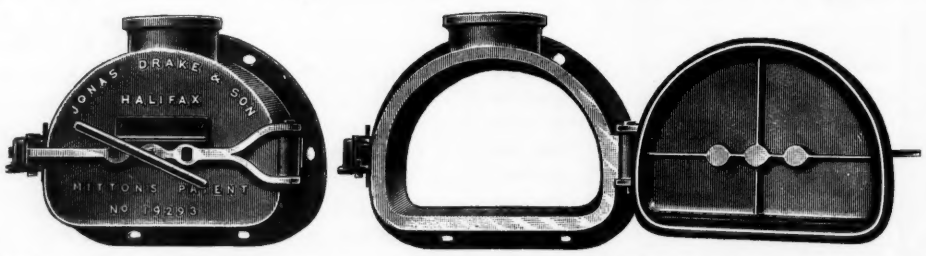

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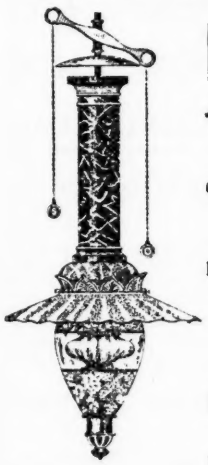

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A 280-CANDLE POWER PLAIN IRON LAMP,

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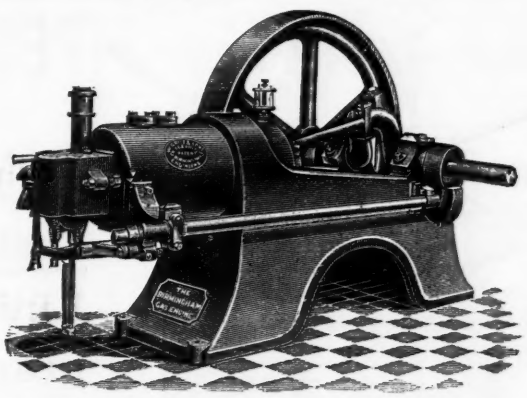

A thoroughly reliable Engine for Commercial or Electric Lighting Purposes. Simple, Strong, Interchangeable.

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"During last winter we used them at all the centres where we cooked by gas; and we shall continue to do so until we find they are superseded, which I consider unlikely."

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"It is easy to manage, very good in its results, and most economical in the consumption of gas. Pastry, bread, cakes, and meat are all equally well cooked and beautifully browned in the oven. The grilling, boiling, and simmering arrangements are perfect."

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LONDON.
Telegraphic Address: "INDEX."

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Telegraphic Address: "GAS-METERS."

[See also Advt. p. 12.

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